

**ASSESSMENT OF THE CONTRIBUTION OF AGRICULTURAL EXTENSION  
SERVICES ON SORGHUM PRODUCTION FOR IMPROVED FOOD SECURITY  
AMONG SMALLHOLDER FARMERS IN RACHUONYO NORTH, HOMA BAY  
COUNTY, KENYA.**

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**JUNE, 2024**

## DECLARATION AND APPROVAL

I declare that this thesis is my original work and has not been presented for an award of a diploma or conferment of a degree in any other university or institution.

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## ABSTRACT

Agricultural extension services play a major role in improving production capacity more so in food crops. This study aimed at assessing the contribution of agricultural extension services on sorghum production for improved food Security among smallholder farmers in Rachuonyo North Sub-County of Homa Bay County. Specifically, the study focused on: contribution of both private public extension services and Influence of credit facilities on sorghum production for improved food security among the smallholder farmers in the study area. A descriptive research design was used. Semi-structured questionnaire was used to collect data. Both descriptive and inferential statistics were reported. Findings revealed that Sorghum farming was dominated by the youth at 62% because majority of this age set are unemployed and therefore have resorted to farming as source of livelihood, 27% aged 36-55 years with only 11% being above 55 years. Binary logistic regression showed that both private and public extension services play a significant role on sorghum production for improved food security ( $t=2.036$ ,  $p=0.043$  and  $t=6.441$ ,  $p=0.000$  respectively). Their influence is distinguished by efficiency in service delivery. Availability of credit facility equally plays a significant role on sorghum production for improved food security ( $t=2.868$ ,  $p=0.004$ ). Food security in the study area was measured in terms of sorghum yield, those with low yield were considered to be food insecure. It is therefore recommended that the private and public extensions services such as distribution of farm inputs and training be scaled up so as to improve sorghum production. Farmers should also be able to access credit facilities such as loans without any limitation. The findings of this study were useful to organizations and agencies already operating in the study area to identify their weaknesses and strength in service delivery.

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## **DEDICATION**

I dedicate this work to my family including my wife Monica Awiti, my children Eliud, Noela and Joshua, my parents and siblings for their support and endless prayers through the study period. May our good God bless you abundantly.

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## **ABBREVIATIONS AND ACRONYMS**

ADRA: Adventist Development and Relief Agency  
ASAL: Arid and Semi-Arid Land.  
CAAES: Central Administration Agricultural Extension Services.  
CIAT: The International Centre for Tropical Agriculture  
CIG: Common Interest Group  
CRS : Catholic Relief Services  
FAO: Food and Agricultural Organization  
FFS: Farmers Field School  
GDP: Gross Domestic Product  
GOK: Government of Kenya  
ILRI: International Livestock Research Institute  
KALRO: Kenya Agricultural and Livestock Research Organization  
KASAL: Kenya Arid and Semi-Arid Land  
KIHBS: Kenya Integrated and Household Budget Survey  
KNBS: Kenya National Bureau of Statistics  
MALR: Ministry of Agriculture and Land Reclamation  
MDG: Millennium Development Goals  
NASEP: National Agricultural Sector Extension Policy  
NGO: Non-Governmental Organization.  
SRA: Strategy to Revitalize Agriculture  
T&V: Training and Visit  
WFP: World Food Programme

## **CHAPTER ONE**

### **1.0 INTRODUCTION**

This chapter has been arranged to give the background information on the contribution of agricultural extension on improved food security among small holder farmers globally narrowed down to African continent then Kenya as a country. It also covers statement of the problem, study objectives, research questions, significance of the study, limitation of the study and assumptions as discussed below

#### **1.1 Background Information.**

Agricultural extension is the application of farm practices that would improve farmers living standard such as food security Extension services create a link between farmers and research and information through education. Through this platform, various ways of boosting agricultural productivity are incorporated with research with the aim of improving farmers standard of living (Chege, Lemba, & Semenye, 2018).

Food demand is projected to rise between 59 percent to 98 percent by 2050 (Elferink & Schierhorn, 2016), with the largest increases anticipated in sub-Sahara Africa, South Asia and East Asia, however there is no surety of this anticipation due to various factors such as climate, social and political factors. The number of undernourished individuals worldwide is estimated to be 850 million, and it has barely changed between 1990–1992. Hunger hotspots, which are characterized by a high frequency and pervasiveness of food insecurity, particularly during extended periods of crisis, are of particular concern. (Robertson et al., 2019)

African small holder farmers are categorized on the the basis of the agro- ecological zones in which they operate the type and composition of their farm portfolios and landholding and on the basis of annual revenue they generate from farming activities (World Bank; CIAT, 2015). In areas of high population densities, smallholder farmers usually cultivate less than one hectare of land, which may increase up to 10 hectares or more sparsely populated areas.

On the basis of farm revenue, smallholder farmers range from those producing crops only for family consumption to those who earn income from their farming enterprise. Food insecurity has been noted

to be the major cause of poverty in the world more particularly African states. The overall poverty situation in Kenya was approximately 56 percent of the population estimated at 30 million people (Mwadalu & Mwangi, 2013). In 2011, the government of Kenya reported that about half of her estimated population of 38.5 million people was poor and some 7.5 million people lived in extreme poverty while over 10 million people suffered from chronic food insecurity. It was also noted that most communities that lived in arid and semi-arid region are greatly exposed to food insecurity due to recurring drought that interferes with crop and livestock productivity (Fitzgibbon, 2012).

One of the solutions therefore lies in the inclusion of Agricultural extension in food productivity through training of farmers with the aim of improving their standard of living in addition the adoption of drought resistance crops such as sorghum that can withstand the harsh climate in the ASAL region thus improving food security. Statistics by the Kenya Arid and Semi-Arid Lands programme (KASAL) (Fuglie & Rada, 2013) indicates that the government spent about £40-60 million annually on famine relief with NGOs spending an equal amount. Approximately 10 million Kenyans mainly in the ASAL areas need food relief (World Bank; CIAT, 2015). Increasing agricultural productivity can be the best solution towards improving food security in the country, however this remain a major challenge especially due to the effect of climate change and variability that is likely to result to prolonged drought with intermittent floods which are coupled with shorter recovery time (Birch, 2018). According to comprehensive food security and vulnerability report by World Food Programme agriculture is the mainstay of the Kenyan economy, contributing 30 percent of GDP. Notably however Kenya is a food deficit country, more particularly Homa Bay county where Farmers find it hard to access credit facilities needed to buy inputs such as fertilizers, pesticides and improved seed variety due to the conditions laid out to access them (WFP, 2016). This impact has forced majority of farmers to cultivate crops on small pieces of land measuring less than 0.05 acres, consequently resulting into low crop yield has thus affecting food security and the economy of the study area.

In response to issues affecting food security in Kenya, the government has managed to commit only 4.5 percent annual budget allocation to the ministry of agriculture. The amount that is considered far much below what the ministry requires in its operations including financing agricultural extension services. To overcome this challenge, the government of Kenya has closely been sourcing support from international organizations such as World Bank and FAO to improve agricultural food production (FAO, 2014). In response, the organizations have responded in various ways including the

introduction of different types of agricultural extension services such as Training and visits (T&V) approach that was sponsored by World Bank (WFP, 2015). The system has its own short comings especially in Kenya and Nigeria (Musa, Aboki, & Audu, 2013), the system came under serious criticism both in Kenya and Nigeria because of top-down approach, inefficiency, ineffective and not financially sustainable. It was regarded as not serving the farmers' interest instead it was a profit-oriented system.

Another extension model used in Kenya was the integrated rural development project, the model was introduced with the support of the World Bank to implement an integrated extension approach. The goals were to address the constraints of small holder farmers and increase their food productivity thus improving food security; however such actions did not pay so much attention to sorghum farmers (WFP, 2015). This crop was given low value and nobody paid attention to its production. It was considered a less profitable crop until recently when scientists realized its economic value of being drought resistant and high nutritional value. In the East Africa region, sorghum is replacing other crops and is considered as a staple food among most communities notably in the Eastern and Western part of Kenya (Beinah, Kunyanga, & Ngugi, 2020).

The other model used in Kenya is the Farmer Field School (FFS) sponsored by Food and Agricultural Organization. This approach was adopted following its success in training Asian farmers on integrated pest management. The approach was first introduced in 1995 by the Food and Agricultural Organization (FAO) special programme for food security. Through observation and learning-by-doing, farmers are able to internalize the advantages of improved technology and adopt new practices in their own fields (Waddington, et al., 2014). Davis et al., (2012) evaluates the effectiveness of Agricultural extension services by looking at the impact of scaling up of farmers field school in Kenya, Tanzania and Uganda. Using estimates, Waddington concludes that Farmer Field school extension approach improve farmer's knowledge and adoption of beneficial practices and reduce overuse of farm inputs such as pesticides. This model has since been adopted by various county governments in Kenya and NGOs. In Rachuonyo North Sub-County area, Homa Bay County, Extension services are offered by the county government and Private organizations such as NGOs including One Acre fund, Homa Hills community development, religious organizations such as Catholic relief food organization, Parastatals such as Kenya Agricultural Livestock and Research Organization (KALRO) and International Livestock Research Institute (ILRI). Most of the

institutions provide FFS extension model, where farmers come together to form a group, they're taught on various issues affecting agriculture. The extension officers are facilitators and guide farmers throughout the discussion (Fabregas, Kremer, Robinson, & Schilbach†, 2017).

In 2015, the Kenyan government embraced a slogan called “NJAA MARUFUKU KENYA”, whose main intention was to improve food security among its population, this plan was developed in the line with millennium development goal (MDG), whose one of the goals was to reduce hunger and poverty in Kenya by 2015.

Rachuonyo North Sub-County is estimated to be having a majority of its population living below poverty level According to Kenya Integrated and Household Budget Survey (KIHBS) (KNBS, 2016). The poverty level in the region is estimated to be at 52.9 per cent, about 75% of its population is still facing food insecurity and for that matter, sorghum being a hardy crop characterized by drought resistance, pest and disease resistance traits is considered to be a best option of improving food security in this region. The study therefore examined the assessment of the contribution of agricultural extension services on sorghum production for improved food security among the small-scale holder farmers in Rachuonyo North Sub-County of Homa Bay county.

## **1.2: Statement of the Problem**

The World Bank (2000/2001) estimates that about 75 percent of poor people, defined as people who have to survive on less than one dollar a day, live in families of farmers and farm labourers. This implies that any program aimed at poverty alleviation has to be given considerable attention to agricultural development. Agricultural extension is an important element in such an agricultural development program. According to comprehensive food security and vulnerability report by World Food Programme (WFP, 2016) .In Homa Bay County, food insecurity is a serious issue, especially in the Rarachuonyo North Sub-County, the study area for this research. This is attributed to factors such as drought, crop, pest and diseases, HIV/AIDS pandemic and inadequate extension services on sustainability of food crop production. In Rachuonyvo North area, sorghum farming forms part of livelihood among the small holder farmers (Ngode, Ng'eno, & Anjichi, 2021). Collaboration among the various agencies including county and national government, NGOs and international organizations such as Food and Agricultural Organization (FAO) and world bank have

put a number of measures to mitigate on food insecurity among them creating a link between agricultural extension services in sorghum farming. However, most of the studies conducted in this area are not addressing pertinent gaps such as contribution of private and public extension services and influence of credit facilities on sorghum production for improved food security. (Tittonell & Giller, 2013) This study sought to find out the assessment of the contribution of agricultural extension services on sorghum Production for improved food security among smallholder farmers in Rachuonyo North Sub- County of Homa Bay County.

### **1.3: Study Objectives**

#### **1.3.1: Overall Objective**

The overall objective of the study is to assess the contribution of agricultural extension services on sorghum production for improved food security among smallholder farmers in, Rachuonyo North Sub-County, Homa Bay County.

#### **1.3.2: Specific Objectives**

The specific objective of the study includes to:

1. To determine the contribution of private extension service on sorghum production for improved food security among smallholder farmers in the area of study.
2. To determine the contribution of public extension services on sorghum production for improved food security among smallholder farmers in the area of study.
3. To determine the influence of credit facility on sorghum production for improved food security among smallholder farmers in the area of study.

### **1.4: Research Questions**

The study was guided by the following research questions;

1. How does private extension services contribute to improved sorghum production for food security among smallholder farmers in the area of study?
2. How does public extension services contribute to sorghum production for food security among smallholder farmers in the area of study?
3. How does access to credit facilities improve sorghum production for food security among small holder farmers in the area of study?

### **1.5: Justification of the study**

The study sought to identify the contribution of both private and public extension services and influence of credit facilities on sorghum production for improved food security among small holder farmers in Rachuonyo North sub-county, Homa Bay County.

This information will be useful for organizations and agencies interested in supporting sorghum farmers with the information dissemination that would eventually improve crop production. The findings will also be important to the existing organization and agencies to implement and strengthen on their extension education strategies and service deliveries. In addition, farmers would also be able to get new knowledge that would boost their crop production.

### **1.6: Scope of the Study**

The study covers the assessment of the contribution of agricultural extension services on sorghum production for improved food security among smallholder farmers. The geographical scope of the study was Rachuonyo North Sub-County in Homa Bay County, which has three wards namely; Kibiri Ward, West Ward and North ward. Majority of farmers in this area practice crop and livestock farming, sorghum and maize being popular crops grown in the area.

### **1.7: Limitation of the Study**

The study only focused in Rachuonyo North Sub-County, Homa Bay County leaving out other small-scale holder farmers from the other areas within Homa Bay County that grows sorghum and is faced with similar challenges of food insecurity. Rachuonyo North has the best ecological conditions that support sorghum production and it's among the parts of the county that is faced with food insecurity.

### **1.8: Assumption of the Study**

It was assumed that:

That there would be enough farmers to give information about their involvement in extension services: Extension is the major factor responsible for improving food security in the study area: Sorghum is the major crop grown in area of study.

## **1.9: Operational Definition of terms:**

- Agricultural Extension:** Refers to giving farmers knowledge of agronomic techniques and skills through training and offering advisory services that would improve their farm productivity and living standard.
- Food security:** According to the study, it is the situation when all people eat all times, have physical and economic access to sufficient safe and nutritious food that meets the dietary needs and food preferences for an active and healthy life.
- Small holder farmers:** According to the study, these are farmers who produce relatively small food volumes on small plots of land usually less than one hectare. Majority of these farmers produce crops for family consumption.
- Assessment:** According to the study it is the systematic basis for making inferences and judgement about the contribution of agricultural extension on sorghum production.

## **CHAPTER TWO**

### **REVIEW OF THE LITERATURE**

#### **2.0 Introduction**

This chapter reviewed the aspects of agricultural extension globally and narrowed it down to the study area. It touches on the existing extension services provider and the influence they have in terms of food sustainability. Among the gaps that this chapter reviewed include: the contribution of private extension services on sorghum production for improved food security, Influence of credit facilities on Sorghum production and contribution of public extension services on sorghum production, summary of review literature and theoretical framework and conceptual framework.

#### **2.1: Contribution of Private Extension Services on Sorghum Production.**

Private extension providers are faced with a challenge to become more effective and responsive (Wanigasundera & Atapattu, 2019). In Sri Lanka, some private extension service providers have partnered with their public counter parts in order to be more effective. This partnership has evolved through introduction of training and visit system (Wanigasundera & Atapattu, 2019). Most private extension are regarded as profit oriented and therefore out of this partnership, innovation in terms of ICT have been introduced of private extension. Most of the countries around the world recognize private agricultural extension as the key factor towards improving food production. They are considered as the best agency suited to improve food security around the world (Okati, Ahmadpour, & Sarani, 2021). They are faced with numerous challenges including low budget allocation, inefficient staff and inadequate agricultural training policies. These challenges are clear indicators that public extension which is mostly run by the government need to be replaced with private extension. Private agricultural extension is perceived to be more efficient in extension service delivery and a key factor in the development of agriculture (Carozzi, Loubet, Acutis, Rana, & Ferrara, 2013).

Studies shows than in Iran, like many other countries that grows sorghum, food security improvement, rural development, farming technology transfer and poverty alleviation depends on the strength of private extension (Ahmadpour & Soltani, 2014). In this regard more attention needs to be focused towards private agricultural extension as a means of improving food security among the small holder farmers and encourage this sector to be more innovative in its operations that would tackle the increased food demand across the world.

Privatization of agricultural extension commenced in Iran 2002 (Rahim, 2014),and it was triggered by inefficiency and poor-quality services offered by public extension services and the financial constraints experienced by public extension agencies due to limited budgetary allocation (Alizadeh, 2019).Most farmers covered under private extension system rated the quality of services offered satisfactory than under public extension .However Privatization of extension, came with its negative impact to farmers, In Europe for instance, the trend towards the gradual commercialization and ultimate privatization of farm advisory services, which began in 1980s,has been disproportionately detrimental to small scale farmers, most of whom cannot afford to pay for advice that was formerly provided free by the government (Labarthe & Laurent, 2013). Even where the advisory services are available and affordable, some small-scale farmers are hesitant to use them because of a perception that such services are primarily intended for large scale-growers. Most of whom cannot afford to pay for advice that was formerly provided free of charge, in addition most of private extension agencies were oriented towards profit making, and therefore the cost of services they offered were so expensive and could not be afforded by small holder farmers.

In Africa, privatization of extension is in the rise due increased demand for services from farmers. The inefficiency in public extension service has led farmers turn to private extension to seek for service. Africa is faced with the major food insecurity that can be tackled by bringing all the stakeholders in agriculture on board including extension officers. Two prominent international exponents suggested that, sustained high level of agricultural production and income are not possible without an effective agricultural service supported by agricultural research that is relevant to farmers (Benor, Baxter, Harrison, & Bank, 2014). In Nigeria, private extension came into existence due to inability by the government to fund the public extension.

According to (Grow intelligence , 2015)the productivity of labor is especially low and growing slowly in Africa. While this decline is multifaceted and attributable to several factors, one particularly interesting factor is a lack of extension services.

Extension services in Africa entailed a wide range of supportive programs that exist around a farmer, including training, market linkage, and technology transfer schemes. Historically, such programs have been government-led, but in Africa these programs are underfunded, and therefore ineffective throughout much of the continent. The importance of these services has become increasingly

apparent. Due to food demand pressure, farmers in Africa have shifted to private extension as a way of improving food security.

Kenya's agricultural expansion is being hindered by a number of problems, one of which being the national extension service's deteriorating efficacy. Agricultural extension is one of the areas in agriculture sector that requires urgent attention in order to improve food productivity especially sorghum crop (Alila & Atieno, 2016) . Debate triggered by inefficient public extension systems in developing countries has called for a greater role by the private sector. The debate is anchored on the premise that the private sector is more efficient than the public sector in extension services delivery (Rivera, Zijp, & Alex, 2012).

Kenya's smallholder farmers have traditionally benefited from two major types of extension systems. The first is the government extension system commonly referred to as public extension whereby the ministry in charge of agriculture plays a leading role. This system focuses mainly on food crops and livestock. System is called private extension that is increasingly replacing the public extension due to its inefficiency in service provision. Private extension in Kenya is run by out growers' companies, the second extension co-operative societies and NGOs (World Bank; CIAT, 2015). All aspects of a crop's production and marketing are vertically coordinated, from research and advice to organizing marketing and even exports, and are characterized by a bottom-up model. The majority of these extension agencies are profit-driven and demand-driven. The performance of the public agricultural extension service in Kenya has been a very controversial subject (Republic of Kenya, 2012). The system has been perceived as top-down, uniform (one-size-fits-all) and inflexible (Republic of Kenya, 2012) Consequently, there has been a desire to reform public extension into a system that is cost effective, responsive to farmer's needs, broad-based in-service delivery, participatory, accountable and sustainable.

Sorghum is one of the crops that have recently been focused on by private extension provider in Kenya due to its increased demand to tackle food insecurity in Kenya (IBP I. , (2017)).Attention has turned to this crop due to its unique nature of survival. Being a pest and disease resistant, most of farmers have turned into growing sorghum crop. The private extension has made a significant contribution to the production of sorghum by: providing subsidized fertilizers, seeds, and farm implements to sorghum farmers; providing advisory services to farmers regarding pest and disease

management strategies and market information that helps them decide where to sell their produce; and providing research services involving cutting-edge farming technology. (Herdt, 2006)

Faith-based organizations such as ADRA-Kenya, NGOs such as one-acre fund, Homa Hills Community Development Organization (HHCDO) are among the organizations providing private extension services in the area of study. They mostly focus on smallholder farmers, particularly sorghum farmers with the aim of giving them practical training in agricultural food production (J. Mbula, 2019). ADRA-Kenya for instance initiated a programme dubbed “Drought elimination” in the study area whose agenda was to train and support farmers in growing drought resistant crops such as sorghum (Ministry, 2009). Farmers who prescribed to the doctrine of Seventh Day Adventist church were grouped into different categories. They were trained and provided with necessary farm inputs. This arrangement had less impact on improving food security because it only favored a particular group of farmers and not the entire population of farmers.

The common misconception among farmers regarding private extension services is that they are prohibitively expensive and unaffordable, but in reality, they are efficient in service delivery (Kassam, 2017).

## **2.2: Credit facilities.**

Credit facilities plays a crucial role of eliminating financial constraints especially among rural small holder farmers who have limited capital to invest in farming activities (Hosseyni, Khaledi, Ghorbani, & Brewin, 2012). Generally, credit accessibility is important for improvement of quality and quantity of farm produce and it creates a positive influence on food security. Farmers who access credit facilities can easily acquire farm inputs such as seeds and fertilizers that are important aspects of food production.

In Africa, farming practice especially sorghum production has been on decline due to sluggish growth of production factors (Orr,2016). In response to these challenges, African countries have implemented macroeconomic and sectorial reforms aimed at ensuring high and sustainable food productivity, economic growth and poverty reduction that is influenced by availability of affordable credit facilities to farmers (GoK, 2012). Rachuonyo North Sub-County's smallholder farmers have historically relied heavily on credit to purchase agricultural inputs like seeds, fertilizers, and pesticides. However, most of the farmers encounter difficulties obtaining credit facilities because of lending institutions terms and conditions, which include security requirements. (GOK, 2012). Most of

these farmers are disadvantage when accessing loans and other farm inputs on credit basis due to their small scale of operation, compared to their large-scale farmer's counterparts who enjoy access to credit facilities. These selection applications of terms and condition to farmers have greatly affected productivity resulting into food insecurity. According to (GoK, 2012) on food security, all farmers are eligible to credit facilities, national government in collaboration with county governments, have introduced more reforms on credit facilities such as supporting the establishment of more NGOs that give farm inputs on credit basis to farmers and also eliminating repayment terms and condition that prevents farmers from accessing credit, regardless of their size of operations. Credit facility can be looked into the following aspects:

### **2.2.1 Access to Credit by Farmers**

According to (Okuthe,2013) in his study on factors that determine access to credit facilities, rural credit markets in developing countries such as Kenya are not perfect in terms of interest rate that keeps on changing. The flaws are evident in the widely acknowledged fact that many rural households continue to have limited access to credit despite multiple government initiatives to improve household credit availability. When the expanding demand for credit is not met by the official banking industry, many farmers turn to unofficial lending sources (private moneylenders, relatives, etc.). To meet their production and consumption needs. It has been estimated that only five percent of the farmers in Africa and about fifteen percent in Asia and Latin America have had access to formal credit; and on an average across developing countries five percent of the borrowers have received eighty percent of the credit (Sikei, 2009). The majority of people in most developing nations are farmers, and they may adopt new technologies and seize new economic possibilities to boost productivity and income by having access to affordable agricultural loans.

The Interest in access to finance has increased significantly in recent years, as growing evidence suggests that lack of access to credit prevents lower-income households and small firms from financing high return investment projects, having an adverse effect on growth and poverty alleviation (Mutua & Oyugi, 2016). They examined literature on the causal relationship between access to financial services and its impact on agricultural production. The literature, mostly observational from a few case studies, reveals that access to financial services by the rural people (or low-income population segments) can improve their incomes and therefore their welfare.

### **2.2.2 Factors Determining Access to Credit**

In Africa on average, less than 20% of the households have access to formal credit services (Okpara, 2014). Farmers' ability to obtain financing is also influenced by government credit policy. In the recent past, Ministry of agriculture have been coming up with ways that would ensure farmers are able to access credit facilities with ease, part of these measures includes adjusting some of the financial policies including lowering of borrowing interest rate charged by banks to encourage more farmers to borrow agricultural loans (GoK, 2012) In addition, the government has facilitated ways that would enable farmers access agricultural farm inputs such as seeds on credit basis. According to (Osano & Languitone, 2016), Due to a variety of obstacles in obtaining bank financing, a significant proportion of farmers really fund their initiatives out of personal or family savings.

### **2.3 Contribution of Public Extension to Sorghum Production**

Public agricultural extension are services provided to farmers by government organizations with the aim of improving their standard of farming. These services include advice and training in agricultural methods. (Bitzer, 2016), highlights that public agricultural extension services have longed served as key policy lever to accelerate the dissemination of knowledge and skills to promote the adoption of modern technologies. African public extension has come under intense pressure to downsize and reform, contracting out-the use of public sector funds to contract non-governmental and private service providers is often held up as a potential tool in reform efforts (Van Niekerk, Stroebel, Whitfield, Swanepoel, & Van Rooyen, 2014) Public extension contracts are being contracted out more frequently in Zimbabwe and Uganda. This alliance between public and commercial extension has encouraged innovation and improved farmer service delivery efficiency. According to (Al-Fuqaha et al., 2019).

In Kenya public agricultural extension has evolved through various stages since the colonial and post-independence era. The popular approaches were tailored to cater for settler and commercial farming system (MoA, 2013). After independence, more persuasive and educational approaches such as farmers field school FFS were introduced after a failed T&V that was mostly offered by public agricultural Extension.

Programs for public agriculture extension were managed and supported by Kenya's central government until quite recently. On the other hand, county governments now have some of these duties. The issues that were faced in the past are still not entirely resolved by these changes. Public extension continues to place more emphasis on components of crop production with minimal consideration for other elements like marketing, value addition, and other quality and standard of inputs (Njagi, 2019).

Due to increased food insecurity, public agricultural extension has tremendously done well but not to the level of expectation by the farmers. Majority of farmers are smallholder farmers and live in rural areas, cultivating farm areas that are approximately 2 hectares (Pius & Chang'ach, 2013). This is an added advantage to extension officers who considers delivering services on such farmers more efficient than large scale farmers. The market for sorghum has recently surged, and farmers in the Nyanza region have partnered with Kenya Breweries Company Limited to cultivate sorghum as a result of the company's recent resurrection. This has been made possible through engaging Ministry of agriculture in various counties. Public extension has been involved in this initiative to train farmers and disseminate crucial information necessary in sorghum production. This has also seen the development of sorghum value chain and collaboration between multinational companies, plant breeder, intermediary suppliers and sorghum growers (Van Wijk & Kwakkenbos, 2013). Such competition between multinational breweries has spurred the rapid spread of this value chain and sorghum beer is currently produced in the whole of East African countries (Diageo,2013),more small holder farmers are beginning to get out of food insecurity due to such development which is spear headed by Ministry Agriculture through various public extension.

Agricultural extension should link farmers to other economic actors and facilitate the exchange of agricultural expertise, technologies, and information regarding sorghum production. The public extension service is therefore one of the critical change agents required to transform subsistence farming such as sorghum production among small holder farmers to boost food security (MoA, 2014) Research indicates that the public sector had a long-standing dominance over the extension service and had a positive impact on food production as a result of new technologies. However, due to a number of factors, including poor governance in important agricultural institutions, an overreliance on rain-fed agriculture, and unfavorable climate conditions that affect production, the public sector's performance has significantly declined.(MoA,2014) These constraints must therefore be addressed

especially in the area of study so as to improve food security Rachuonyo North sub county farmers gets public agricultural extension services from the county government of Homa Bay county which to some extent does not offer this services to farmers satisfaction. Absolutely, the Homa Bay County government's public extension services have greatly improved food production through their partnership with the Kenya Agricultural and Livestock Research Organization, which is based in Kisii County. As a result, multiple plant breeding system multiplication sites have been established in areas including the North Rarachuonyo, Rangwe, and Kasipul Kabondo sub Counties in Homa Bay County. (MoA,2014)

#### **2.4 Summary of Review of the literature**

Agricultural sector extension service plays an important role in sharing knowledge, technologies and agricultural information and in linking the farmer to other actors in the economy, In order to improve subsistence farming and hence increase food security, it is consequently one of the essential change agents needed (Ministry, 2009). Due to their effectiveness in providing services, farmers prefer working with private extensions over public ones. According to studies, private extension is profit-oriented and is therefore particularly concerned with providing farmers with high-quality services. In sorghum growing areas such as Rachuonyo North Sub-county, (GoK, 2010). Extension programs have served as the primary means of disseminating information and knowledge about agricultural technology, encouraging adult education in rural areas, and assisting farmers in developing their technical and managerial skills. Supporting agricultural extension programs is expected to be a top priority for agriculture stakeholders since they will assist boost farm productivity, farm revenue, decrease poverty, and reduce food insecurity. Agricultural extension should be developed by quick hiring, continual training of extension workers, and provision of sufficient logistics in order to meet all of this demand.(MoA,2013) The accessibility of credit facility by sorghum farmers, affects its aggregate productivity, most importantly its impact varies depending on the level of sorghum farming. In developing countries, an increased access to credit facilities by farmers increases agricultural productivity. Research indicates that having access to credit or other financial resources significantly reduces hunger, with the productivity channel playing a major role in this effect.

Supporting any type of generating asset, includes real estate and farm equipment, is the main goal of credit. It offers many farmers the tools they need to change how they operate. Producers that use

credit are no longer constrained by money problems, especially small-scale sorghum producers who have little money to spend in their operations

In the area of study, many rural families lack access to credit, and since the official banking industry is unable to meet the rising demand for credit, many farmers are turning to unofficial lending sources to meet their needs for both production and consumption. These challenges are attributed to the fact that some credit facilities are too expensive for farmers to service, they attract high interest rate which may be expensive to farmers. The ministries of agriculture in collaboration with the county governments have initiated a program that has attracted international organization to invest in extension or offer financial support for hiring extension staffs or encourage this (Njagi, 2019) . Less than 20% of families in Kenya, for instance, have formal credit services available to them on average. This deficiency in credit availability is a result of low population densities, inadequate transportation, and inadequate communication Farmers in Kenya are not equally likely to have access to lending facilities. The majority of banks providing credit facilities have their own terms and conditions. For example, the availability of collateral, such as a land title deed, which not all farmers can furnish, would determine how much credit sorghum farmers in the study area could get. facilities over much of the African continent.

Most of the land is communally owned with no individual title deed. Access to credit by farmers also depends on the government policies (Okati, Ahmadpour, & Sarani, 2021).

## 2.5: Theoretical Framework

The overall objective of the study is to assess the contribution of agricultural extension on sorghum production for improved food security in the study area. This theory reflects on dissemination of knowledge from extension officers to farmers, herein referred to as learners.in a cluster of training or class, we have farmers of different age, gender and level of education. These factors will influence their attitude towards learning training, in addition, there are also other factors categorized into to two groups such external and internal factors that will influence farmers participation in a training session. This study was guided by Adult Learner’s characteristic theories as demonstrated in the figure below.

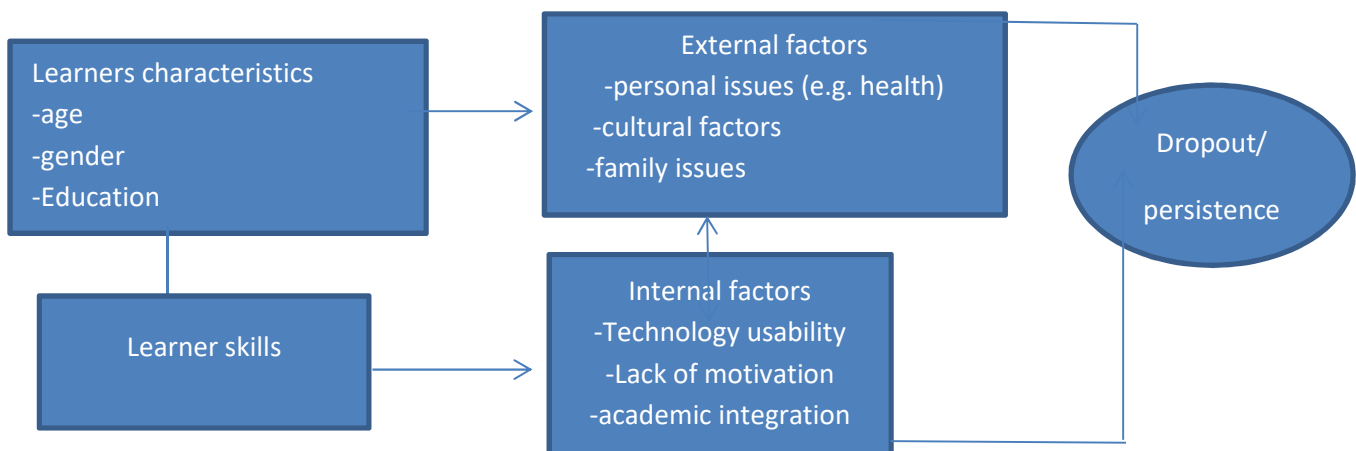


Figure 1: Theoretical framework showing learners characteristics and perception towards learning process. (Cham,2023)

The major claims of these theories are that adults are independent minded and self-directed and therefore they need to be left free to direct themselves in terms of what content they want to learn and this depends a lot on factors such as level of education, age and gender. Thus, extension services delivery depends on the willingness of farmers and factors stated above to participate in learning process and their needs during farming practices. The main the purpose of agricultural extension is to disseminate information to farmers that is helpful in farming activities (Korhonen., 2010). A strong agricultural advice service is related to the amount of food produced. Learning alters the traditional perception of certain cultural beliefs among farmers, such as those who have developed a particular mentality about a particular farming method, those who have developed a negative attitude toward certain crops, and those who practice an outdated farming system and are unaware that this is one of the causes of food insecurity (Goddu, 2012). ).

To improve crop yield, it is important to expose farmers to training. In particular, the officers (learning facilitators) must seek participant (learner) viewpoints on what subjects to cover and allow them to work Adult learners (farmers) must be actively engaged in the learning process by teachers (extension agents). Theoretical framework should include social capital theory as well as potential external and internal influences on farmers on projects that reflect their interests (Taylor, 2009).

## **2.6: Conceptual Framework**

A conceptual diagrammatic explanation of the statement problem.it is an explanation of interplay among the variables that will be identified as useful in the study

**(Independent variable)**

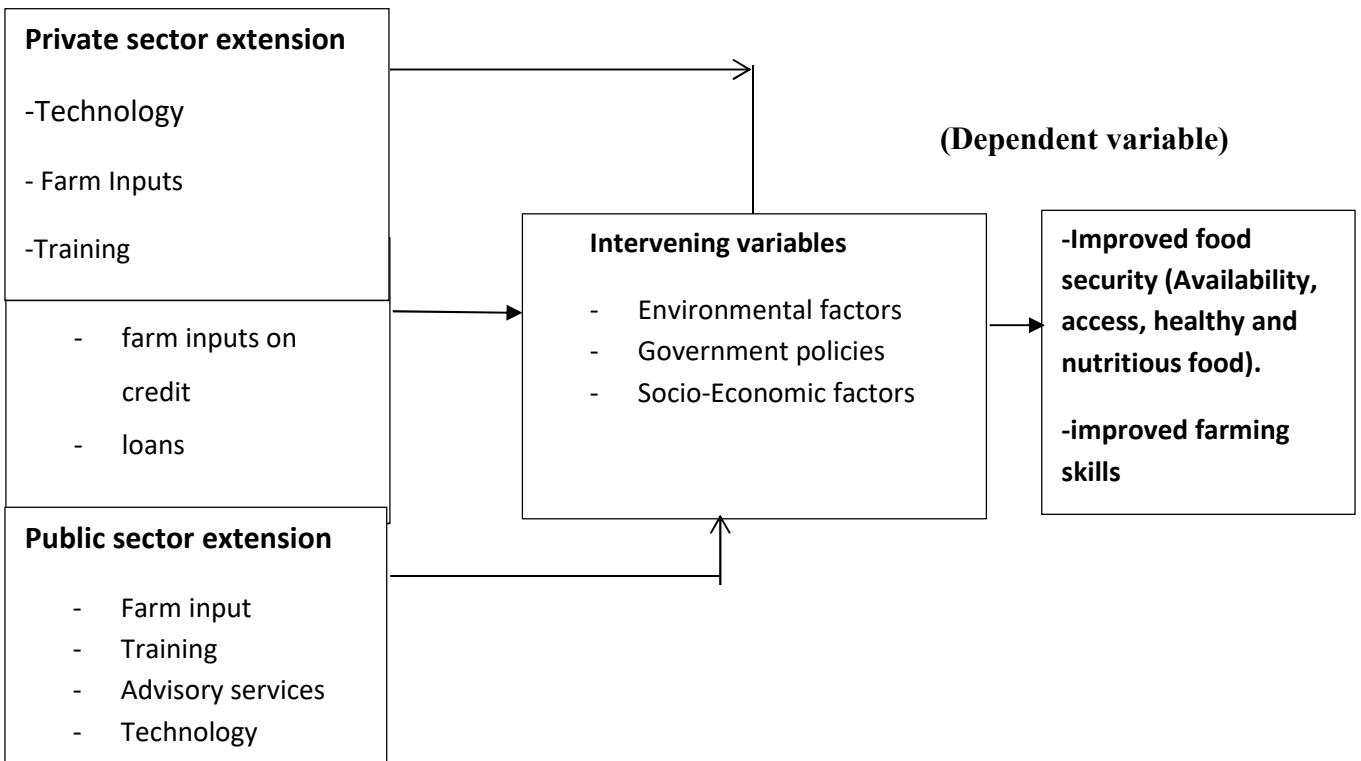


Figure 2: Conceptual framework showing interplay among the variables that was used in the study (Bas swaen,2020)

Figure 2 above shows the frame work which conceptualizes how the variables of the study will related to each other. Both independent and dependent variables depend on each other and create an input-output relationship, while intervening variables play the other role of supporting output. Independent variables run from the left and they indicate input (raw materials) that facilitates the role of agricultural extension services that will go through the process (intervening variables) which acts as a substitute when the two variables fail to function or it supports independent variable to achieve its end result such as high sorghum productivity (dependent variables).

The independent variables include: Private Sector Extension that provide services through training of farmers, giving farm inputs, advisory services, credit facility which is manifested in form of farmers accessing farm inputs on credit, loans, grant to support agricultural practices and public sector Extension on agricultural extension services by providing farmers with, training, research, farm

inputs such as seeds and farm machineries, financial support in form of short-term loans. The independent variables interact with other variables in the periphery (intervening variables) to produce the end results such as increased sorghum yield and improved farming skills.

## **CHAPTER THREE**

### **RESEARCH METHODOLOGY**

#### **3.0: Introduction**

This chapter gives an overview of: location of the study, research design, target population, sample size determination, research instruments, piloting of research instruments, the procedures for data collection and analysis.

#### **3.1 Study Area**

This study was conducted in Rachuonyo North Sub –County of Homa Bay County. In the following wards: West ward, North ward and Kibiri Wards. Homa Bay County covers an area of about 4, 267km<sup>2</sup> and is located in the South Western Kenya along Lake Victoria. It borders Siaya and Kisumu Counties to the North, Kisii and Nyamira counties to the East. Rachuonyo North Sub-County border's Lake Victoria to the north and it stretches from Kendu Bay town to Nyangweso market.

Agricultural activities in Homa Bay County are divided into several Agro Ecological Zones (AEZ's), Rachuonyo North-Sub-County area is found in the lower midlands (LM2) which is suitable for growing millet, sorghum and cotton. The area of study experiences a temperature range of 17.1 °c to 34.8 °c and annual rainfall of 700 to 800mm which is adequate for sorghum production Rarachuonyo North Sub-County has black cotton soil suitable for growing sorghum and cotton (MoALF, 2016).In addition the choice of study area was informed by food insecurity challenges that residents of this area faces. See appendix 2 for the map of study area

#### **3.2 Research Design**

Descriptive research design was used as described by Mugenda and Mugenda (2003). Descriptive design was used so that the characteristics of this population can be known, whether they are food secure or insecure. It describes the state of issues as it exists, (Kothari & Gaurav, 2014). The semi-structured questionnaires were administered to obtain data on the contribution of both public and private extension service provider and the influence of credit facilities on sorghum production for improved food security among smallholder farmers in Rachuonyo North Sub-County. Additionally, the study assessed the contribution of agricultural extension services on sorghum production for improved food security among the smallholder farmers in Rachuonyo North Sub-County. The

questionnaire was administered by relevant enumerators who understood what data collection entails. The data obtained was used to answer the objectives that this study intended to achieve.

### 3.3 Target Population

This study targeted smallholder sorghum farmers in Rachuonyo North Sub-County of Homa Bay County. The farmers are the primary beneficiaries of the extension services and are the source of information regarding food security status. Therefore, they become an important element in the study. The agricultural extension officers create a link between the farmer and the research and the source of information to farmers on how to improve food productivity.

### 3.4 Sample Size Determination

The sample of the study included smallholder sorghum farmers of Rachuonyo North sub-county. the previous study conducted by one-acre fund showed that there is a total of 3350 smallholder sorghum farmers in the study area and out of this, not more than 25 percent have ever been exposed to extension services. To avoid biasness and pick the exact sample size, the following formula as suggested by (Charan & Biswas, 2013) was used for calculation of unknown population size

$$\text{Sample size} = \frac{Z_{1-\alpha/2}^2 p (1-p)}{d^2}$$

$Z_{1-\alpha/2}$  = Is standard normal variant (at 95% confidence level). As in majority of the studies  $p$  values are considered significant below 0.05 hence 1.96 is used in formula

$P$  = Expected proportion of population of farmers from previous study exposed to extension services.

$d$  = Absolute error or precision.

$$\frac{1.96^2 \times 0.25 (1-0.25)}{0.05^2} = 288$$

Table 1 below shows the number of farmers that were sampled for the study.

Table 1: proportionate sampling of sorghum farmers in the study area

Study location	Farmers in target ward	Sample size
West ward	1000	1000/3350(288) =86
North ward	1500	1500/3350(288) =129
Kibiri ward	850	850/3350(288) =73
Total	3350	288

### 3.5 Sampling Method

purposive sampling was employed to pick sorghum farmers in the study because it avoids bias and ensures that there is equal representation. A stratified random sampling technique categorized smallholder farmers into different subgroups or strata based on their acreage and administrative area. Then subjects were selected randomly and proportionately. Purposive sampling was used to select the other stakeholders, including administrators, farmers' representatives, officers from the Sub-County agricultural offices, NGOs, and officers from the National Government.

### 3.6 Data Collection Instruments

A semi-structured questionnaire was designed to collect information from sorghum farmers and had three parts. The first part contained socio-economic profile of the respondents such as gender, age, civil status, family size, estimated farm income, farm size, and highest level of education. These were captured through closed questions with options to choose from.

The second and third parts contained questions regarding independent variables including: Contribution of private extension provider, credit facilities influence and contribution of public sector involvement in sorghum production measured against sorghum production, using a Likert scale. The respondent would explain to what extent they agree with certain statement, for example the Likert scale ranged from 1-5 with: 1-Strongly Disagree, 2-Disagree, 3-Neutral, 4-Agree, 5-Strongly Agree.

Two research assistants were selected and trained for half a day on the background and purpose of the study; sampling procedures; interviewing procedures and techniques used; translating the questions to local languages and how to ask them. The two trained assistants and the researcher, as the coordinator, visited the sorghum farmers in their farms accompanied by the guide (village elder) and interviewed farmers.

### **3.7: Pilot Study**

A pilot study was conducted in Rarieda Sub-County of Siaya County in Uyoma village. The pilot study was informed by the fact that Sorghum is grown in this area and its ecological condition suits its production. This area is equally faced with food insecurity challenges just like the area of study. Before collecting the data, the researcher established the validity and reliability of the research instruments as explained below:

#### **3.7.1: Validity of Research Instrument**

Validity refers to the degree to which the research conclusions are sound (Taherdoost, 2016) It includes internal and external validity, measurement, interpretative and statistical validity. For content validity the research tools for this study were ensured by submitting them to the supervisor/expert for review, critic and input.

#### **3.7.2.: Reliability of Research Instruments**

Reliability is the application of a valid measuring instrument to different groups under different conditions, resulting in the same observation (Zohrabi, 2013). The pilot test was conducted on 10 sorghum farmers (3% of the sample size) according to Mugenda and Mugenda (2003). The research instruments were administered to the same pilot group twice after a given interval and the results compared. The comparison was done using Cronbach's Alpha Coefficient to indicate the level of reliability of the research instruments. Cronbach's Alpha,  $\alpha$  (or coefficient alpha) test was used to measure reliability. In general, an  $\alpha$  score of 0.7 and above is usually acceptable. Data entry and analysis was done using SPSS (v25). The instrument was found to be valid, reliable and had suitable language for data collection.

### 3.8: Data Analysis

The interviewed farmers were first described and put into two groups *viz.*, food secure or food insecure based on their sorghum yield. This was later used as the response variable for regression analysis. Descriptive statistic such as frequencies, percentages, means and standard deviations and graphics were used to report the analysis and visualization of the questionnaire data based on whether one practiced or not. Data was analyzed using SPSS version 25 statistical software. All the tests were done at 95% confidence level.

Furthermore, Chi-square statistics was used to test for association between those who grew sorghum and the socio-demographic variables such as age, location, gender, education level and occupation.

The Chi-square is given by the formula:

$$\chi^2 = \frac{\sum_{i=1}^n (O_i - E_i)^2}{E_i}$$

Where;

$\chi^2$  – is the Chi-square statistics tested at 95% confidence level

$O_i$  – the observed values (frequencies) sampled from  $i = 1, \dots, n$

$E_i$  – the expected values (frequencies)

Moreover, a multivariate logistic regression was fitted to assess the effect of public and private extension services and access to credit on sorghum yield for household food security. The model was picked based on the nature of the response (food secure/insecure). The model specification was as follows:

$$Y = \exp(\beta_0 + \beta_1 X_1 + \beta_2 X_2 + \dots + \beta_n X_n + \varepsilon_{ij})$$

Where;

Y – is the response variable, sorghum yield

$\beta_0$  – is the intercept

$\beta_i$  – the estimates of the regression parameters (slopes) for  $i = 1, \dots, n$

$X_{iS}$  – are the independent variables (access to credit, public extension services, private extension services) for  $i = 1, \dots, n$ .

### **3.8 Ethical considerations**

The researcher established a basis for trust with the participants in the study and the consent form was given to the willing participants individually after answering their concern and assuring them their anonymity and privacy will be maintained. Permission was sought from the Ethics Review Committee (ERC), the local authorities, adherence to the Covid-19 protocols as well as from the respondents with explanations as to how research would contribute to the enhancement of food security and the impact on socio-economic status. During the research, the privacy, confidentiality and dignity of the respondents was considered assuring the respondents that their privacy is not breached in any way and that data collected is used purely and absolutely for academic research purposes. Also, the roles, responsibilities and rights of each participant including denying to participate or withdrawing at any stage of the study was communicated to them before conducting the study. This study did not exclude any person or group of participants except those less than 18 years. All stated respondents had an equal chance of participating in the study without any kind of discrimination. The researcher informed all participants of the needed information in the study, their roles, benefits, and rights. A feedback session was held to disseminate the results of the research to the community and to thank the group for their assistance during the study. The soft copy of the data was stored carefully. The soft copy of data is kept in a coded file on my computer and external hard disk. After analyzing data, findings will be submitted to the School of Agricultural and Food Sciences. No one will get access to the collected data, except in a special case with permission and recommendation from high institutions that provided this research permission with equally an assurance of confidentiality and anonymity of data sources.

## CHAPTER FOUR

### RESULTS AND DISCUSSION

#### 4.0: Introduction

This chapter shows the results and discussion on the assessment of the contribution of agricultural extension services on sorghum production for improved food security among the small holder farmers in Rachuonyo North sub-county of Homa Bay County. It is divided into two sections: The socio demographic characteristics and inferences. The analysis is presented as per the objective.

#### 4.1 Socio demographic characteristics

Kibiri Ward represented 23% of the respondents, North and West ward had 43.6% and 33.4% representative respectively. Females who participated in this study were 55.4%, whereas the male gender was 44.6%. Majority of the participants were married at 49.8%, 37.3% being single, the widowed at 9.4%, and the divorced and separated at 1.4% and 2.1%, respectively. Most of the respondents were within the 18-35 age bracket, 27.2% were between 36 to 55years and 11.1% were above 56 years old. The sampled participants were still young and energetic. Nearly half of the participants had no formal education, 17.8% had a primary certificate, 8.7% had a secondary credential, and 3.8% had a college certificate, 8% had a diploma, 10.8 a degree, and 2.8% had a postgraduate. Regarding occupation, 52.3% cited unemployed, 22.3% were self-employed, 12.2% were employed, and students were 10.8%, whereas 2.4% had retired. The following list of tables shows data of different socio demographic characteristics in the study area.

**Table 2: Number of respondents in each ward**

Ward	Frequency(N)	%
Kibiri	66	23.0
North	125	43.6
West	96	33.4

**Table 3: Gender distribution among the respondents**

<b>Gender</b>	<b>Frequency(N)</b>	<b>%</b>
Female	159	55.4
Male	128	44.6

**Table 4: Marital status of the respondents**

<b>Status</b>	<b>Frequency(N)</b>	<b>%</b>
Single	107	37.3
Married	143	49.8
Widowed	27	9.4
Divorced	4	1.4
Separated	6	2.1

**Table 5: Age distribution among the respondents**

<b>Age group</b>	<b>Frequency(N)</b>	<b>%</b>
18-35 years	177	61.7
36-55 years	78	27.2
56 years and above	32	11.1

**Table 6: Level of education of the respondents**

<b>Level</b>	<b>Frequency(N)</b>	<b>%</b>
No formal education	138	48.1
Primary	51	17.8
Secondary	25	8.7
Certificate	11	3.8
Diploma	23	8.0
Degree	31	10.8
Postgraduate	8	2.8

**Table 7: Occupation among the respondents**

Status	Frequency (N)	%
Student	31	10.8
Employed	35	12.2
Self-employed	64	22.3
Unemployed	150	52.3
Retired	7	2.4

**4.2: Findings of objective one:****To determine the Contribution of private extension services on sorghum production for improved food security among small holder farmers**

The Introduction of modern technology by private extension on sorghum farming influences sustainability of food security, 62% of the participants cite great extent, 22.4% closely agreed with the statement while 8.7% of the respondent suggest that modern technology can improve food security at a very low extent. It's clear that majority of the respondent (62%). Agree that modern technology offered by private extension came with the introduction improved seed variety, modern farming equipment such as seed drillers among others that saved cost on labor and time consumption. Use of improved seed variety gives high yield on sorghum production. Such varieties mature earlier and therefore can escape draught period that is prevalent in the area of study. This is comparable to new improved variety grown in Nigeria(12KNICSV), improved Deko that flowers in 67 days against 90 days on the average of low existing variety, Ramya (Kulkarani,2019) that has significantly increased sorghum yield thus improving food sustainability.58.2 percent of the respondents agree to a very high extent that providing farmers with farm inputs improves food security. This was closely followed by 22.3 percent of the responded who bank for availability of farm inputs, while very few numbers of farmers that is 4.9 percent suggests that availability of farm inputs improves food security at very low extent. Private extension provider is profit oriented and therefore they tend provide sorghum farmers with farm inputs at a subsidized price in order to maximize on profit margin. Inputs such as fertilizer, seeds and farm tools equipment are essential in food production. Majority of the farmers agree that farm inputs are a great determinant of the quantity of food production. Agricultural production has become dynamic, therefore to sustain food security, farm inputs that are used by

farmers should be upgraded (Okuthe, (2013)).68.3 percent have a strong belief that training of sorghum farmers by private extension providers improves food security to a very high extent, this closely supported by 13.2 percent of the respondent., however only 3.8 percent agreed that training improves food security. Therefore, it's clear, that training exposes farmers to various aspects of farming that can improve crop yield. This includes timely planting and how to control pest and diseases. According to (Stathers, (2013). ) knowledge and skills acquired from any training course, enable farmers to apply them on sorghum production. With this kind of exposure, level of confidence and motivation was built up among farmers through various action plan.

From the three aspects i.e. Technology, training of farmers and distribution of farm inputs offered by private extension were analyzed on a Likert scale, it can strongly be pointed out that private extension provider offers high quality of training that consequently improved food security, followed by improved modern farming technology and finally farm inputs.

The table 8 below shows how three services offered by private extension agencies influences food security.

Table 8: Response rate on contribution of private extension services on sorghum production.

	<b>Modern Technology</b>		<b>Private Ext training</b>		<b>Providing farm inputs</b>	
	<b>N</b>	<b>%</b>	<b>N</b>	<b>%</b>	<b>N</b>	<b>%</b>
Very low extent	25	8.7	11	3.8%	14	4.9%
Low extent	4	1.4	13	4.5%	7	2.4%
Don't know	10	3.5%	29	10.1%	35	12.2%
High extent	70	24.4%	38	13.2%	64	22.3%
Very high extent	178	62.0%	196	68.3%	167	58.2%

Use of modern technology was also identified by farmers as one of the aspects being offered by private extension agencies. Such technologies include: use of improved seed varieties, good agronomic practices such as use of fertilizer as opposed to organic manure was identified among the factors that improve sorghum production.62 percent of the respondents strongly agree that use of fertilizers such as CAN during planting of sorghum results into high yield as opposed to use of

organic manure. Only 6.62 percent of the farmers support the use of organic manure. The preferences of using either manure or fertilizer is brought about by the effects on the crop. Farmers who oppose the use of organic manure cite the burning effects on sorghum crops and harbor pests and diseases, which consequently result into low sorghum yield. Farmers who prefer to use organic manure are discouraged by the cost of fertilizers.

53.3 percent of the respondents agrees and supports the use of improved seed provided by private extension services at a subsidized price. as opposed to 3.1percent who prefer to use the local seed variety. The largest percentage of farmers who prefer to use improved seed variety argue that they are disease resistant, mature early and have high yield. The table below shows the responses on different types of technology offered by private extension agencies in the study area as compared to old local farming practices. Table 9 below shows the preferences of choice between different use of technology such as use of improved seed varieties against local seed varieties and use of fertilizers against use of organic manure.

Table 9: Responses on the effects of improved modern technology introduced by private extension.

Responses	Farming Technology							
	Local seeds		Improved seed variety		use of fertilizer		use of organic manure	
	N	%	N	%	N	%	N	%
Strongly agree	9	3.1%	153	53.3%	178	62%	19	6.6%
Agree	50	17.4%	90	31.4%	70	24.4%	35	12.1%
Disagree	70	24.4%	40	13.9%	30	10.5%	73	25.4%
Strongly Disagree	158	55%	4	1.39%	9	3.2%	160	55.8%

From the table 9 above, it is evident that farmers from the study area have embraced the use of modern technology in sorghum production than old farming method. This is based on the statistics given by one-acre fund representative in the study area that since the introduction of use of fertilizer and improved seed variety, sorghum yield has increased from 1 bag to 5 bags in the demo plots. at 53.3 %,majority of farmers prefer to use improved and certified seed varieties during planting as

compared to 3.1% of farmers. Improved seed variety have faster growth rate and are resistant to pest and diseases. At 62% farmers prefer to use fertilizer as opposed to use of organic manure at 6.6%.

#### **4.3. Findings of objective two:**

##### **To determine the contribution of Public Extension Services involvement on sorghum production for improved food security among smallholder farmers.**

Public extensions services in the study area are run and managed by the county government. This sector facilitates sorghum production through distributing farm inputs, providing training to farmers and exposing farmers to new farming technology. Of all the three aspects of farming provided by public extension, New farming technology was cited by respondents to be the most factors that improve sorghum production.

Majority of farmers at 65.2% interviewed agree that embracing new farming technology has greatly improved sorghum yield. Some of the technology that have been introduced by public agricultural extension agencies include agronomic practices such as pest and disease control, introduction of market information through mobile phone system, use of fertilizer as opposed to use organic manure. It should be noted that the introduction of fertilizers such Calcium Ammonium Nitrate and Di-Ammonium phosphate by county government, has significantly improved sorghum yield. In addition, farmers enjoy access to these fertilizers at a subsidized price. Only 2.8% of the respondents stated that use of new technology influences high sorghum yield at a very low extent.

Training of farmers by public extension service provider on different aspects of farming is considered as the second-best factor that promote sorghum production in the study area, 59.9% of the respondents agreed that they have been exposed to different crop field practices such water conservation through training. Farm inputs such as certified seeds, farm tools and equipment plays an important role in sorghum production, 55.7% of the respondent strongly agree with this statement. Among the inputs provided by public extension include certified seeds, ploughs and seed drillers at a subsidized price. 30.0% of the respondents agrees that high distribution of farm inputs by public extension provider have significantly improved food security. 3.1% of the respondents however suggests that apart from inputs, other aspects of extension have also improved food security.

The respondents who agree that training of sorghum farmers by public extension officers led to improved food security; 59.9 percent of the farmers strongly agree with the statement to a very high extent. While 24.4 percent come closely to agree with the statement at high extent. From the information provided by Rachuonyo North Sub-County agricultural extension officers, before the introduction of devolved system of government, farmers training was facilitated through a method called Training and Visit method(T&V),however this method was inefficient and was later replaced by Farmers Field School method(FFS) after the introduction of Devolved system of government. Most respondents support's this method as they argue that it is more farmers centered and efficient. The table 10 below shows three aspects of extension offered by public Extension agencies and the response extent to which farmers agree that they influence sorghum production for improved food security based on the question that were asked.

Table 10: Responses on the extent to which three aspects provided by public extension to sorghum production improves food security.

	<b>Inputs distributed by public extension</b>		<b>Training offered by public extension</b>		<b>New farm technology offered by public extension</b>	
	<b>N</b>	<b>N %</b>	<b>N</b>	<b>N %</b>		<b>N %</b>
Very low extent	9	3.1%	11	3.8%	8	2.8%
Low extent	16	5.6%	16	5.6%	18	6.3%
Don't know	16	5.6%	18	6.3%	19	6.6%
High extent	86	30.0%	70	24.4%	55	19.2%
Very high extent	160	55.7%	172	59.9%	187	65.2%

From table 10 above, based on the statistics provided, it is clear that not all farmers have embraced new farming technology and training provided by public extension service. Few of the respondents who don't support any training method pointed out that they were time wasting and had nothing new to improve their sorghum yield.

#### **4.4. Findings of objective three:**

##### **To determine the influence of Credit Facility on sorghum production for improved food security among smallholder farmers.**

Accessing farm inputs such as seeds and fertilizers on a credit basis is necessary for the sustainability of sorghum production. Most of the farm inputs are expensive when accessing them on cash basis given that most farmers in the study area are struggling financially. 75.6% strongly agree that to a very high extent, farmers can only afford to acquire most of the farm inputs on credit basis. Most of the respondent argue that they are faced with hard economic times and therefore they may not part with enough cash for purchasing this input. 1.4% of the respondent are far least agree that inputs can only be accessed on credit basis. This group of respondents stated that there are other methods of acquiring farm inputs apart from using credit such as borrowing from the neighboring farms. However, 69.3 percent of the respondents stated that to very high extent, they have limited access to acquire farm inputs on credit basis, while 19.5% come closer to support this statement. Only 0.7 percent disagrees with the statement.

The ability to access credit depends on the type credit facilities offered such as short term or long-term credit and the agency offering it. In the study area, farmers borrow credit from organizations such as commercial banks, NGOs, Farm Service Agency. Commercial banks credits are cited to be the most expensive to access because of their terms and conditions such as interest rates and security. Credit services offered by NGOs that operates as extension providers were cited as the cheapest to access by farmers because of low interest rates charged. Participants had a strong belief that credit facilities have a positive influence on sorghum production for improved food security. Table 11 in the next page shows the responses which farmers gave on questions that were asked on the extent to which they can acquire farm inputs on credit basis and the extent to which farmers are limited acquire farm inputs on credit basis.

Table 11: Responses on the extent to which farmers can access farm inputs on credit basis and the extent to which farmers are limited to access farm inputs on credit basis

Responses	Accessing Inputs on credit basis		Limitation to access inputs on credit basis	
	N	%	N	%
Very low extent	7	2.4%	2	0.7%
Low extent	4	1.4%	9	3.1%
Don't know	10	3.5%	21	7.3%
High extent	49	17.1%	56	19.5%
Very high extent	217	75.6%	199	69.3%

From the table above, it's clear that majority of farmers have the ability to access credit by 75.6% while 65.6% are limited to access credit. The analysis was done based on farmer acquiring farm inputs on credit basis. Inputs such as seeds, fertilizers and farm tools and equipment are necessary materials needed for sorghum production and without them farmers will not be able to sustain their crop production.

From the information obtained from the local administrators in the study area, some farmers have negative attitude towards borrowing credit and this has greatly affected their farm operation. Some of the reasons why these farmers have kept off borrowing credit include, lack of security requirement, high repayment rate (interest rates) and unavailability of credit institutions in the study area. Table 12 in the next page shows how true or false factors such as security, high repayment rate and unavailability of credit institution may hinder farmers from accessing credit facilities.

Table 12: Factors hindering farmers from getting the required credit amount

	Lack security		High repayment rate		Unavailability of credit institutions	
	N	%	N	%	N	%
False	241	84.0%	53	18.5%	256	89.2%
True	46	16.0%	234	81.5%	31	10.8%

From the table above, among the three factors hindering farmers from accessing credit facilities, High repayment rate was regarded as the most hindering factor that prevents farmers from getting the required amount of credit, with 81.5 percent of the respondents supporting this statement. The interest charged on credit offered depends on the type of credit to be borrowed by a farmer. Such credit can be either short-term credit or long-term credit. Long term credit is expensive to finance than the short-term credit. About 16 percent of the farmers lack security which is a requirement by the lending organizations. 84 percent of the respondents disagree that lack of security hinders farmers from accessing credit. The respondents argue that few numbers of organizations that are available have eliminated security requirement so that they can attract more farmers to take credit from them. Only 10.8 percent of the respondents indicate that credit institutions are not available near their residences, while 89.2 percent differs with them and argue that there is availability of credit institutions near their residence. Majority of the respondents believes that credit institutions are available in the study area and therefore can easily be accessed and examples of institution available in the study areas include those that also offers extension services such as one-acre fund, faith-based institutions, NGO's such Homa Hills Community Development.

#### 4.5 Location and Availability of Services

A Chi-square test was conducted to check whether there is a relationship between availability of services such as credit facilities, trainings and the three areas of study. The number of organizations such as micro-finance institutions, banks that provide credit facilities varies from one area of study to another area of study hence there is an association with the ward where the participant comes from,  $p < 0.001$ . North ward has 101 number of credit facilities which is the highest compared to other two

area of studies. These credit organizations include, Community based organizations, NGOs that provide inputs on credit, religious institutions and micro-finance institutions. Kibiri ward has the least number of credit organizations of about 30 organizations. Various training methods were administered to sorghum farmers; however, training methods have an association with the ward,  $p < 0.001$ . Most of the training methods offered in North Karachuonyo and Kibiri is through farmers field school 88 percent the respondents in Rachuonyo North prefer FFS while 87.88 percent of the respondents from Kibiri ward prefer the same method of training. Majority of the farmers from the wards prefer farmers field school with 72.13 percent of the respondent supporting this. Most of the farmers argue that this method is efficient and more engaging than training and visit method.

Table 13 below shows relationship between services that promote sorghum production (credit facilities, training methods) and the three areas of study.

Table 13: Association between services and three areas of study,

		Ward									
Credit organizations available		Kibiri		North		West		Total		$\chi^2$ (df)	P-Value
		N	N%	N	N%	N	N%	N	N%		
Less than 5		15	50.00%	30	29.70%	20	27.03%	65	31.71%	37.847(8)	<b>0.00**</b>
5 to 10		14	46.67%	64	63.37%	45	60.81%	123	60.00%		
10 to 20		1	3.33%	5	4.95%	9	12.16%	15	7.32%		
20 or more		0	0.00%	2	1.98%	0	0.00%	2	0.98%		
Total		30	100%	101	100%	74	100%	203	100%		
Training Method		Kibiri		North		West		Total		$\chi^2$ (df)	P-Value
Training and visit		8	12.12%	15	12.00%	57	59.38%	80	27.87%	69.50(2)	<b>0.00**</b>
Farmers Field School		58	87.88%	110	88.00%	39	40.63%	207	72.13%		
Total		66	100%	125	100%	96	100%	287	100%		

#### 4.5.1 Effect of private extension, public extension and credit facilities on sorghum Production for Improved Food security

A binary logistic Regression analysis was conducted to examine the impacts of both private and public extension services and credit facilities (predictor variables) on sorghum production for improved food security (Response variable). All variables held constant; It was found out that the predictor variables significantly predicted response variables, a unit increase in private extension services causes a 0.072unit positive impact on food security. A unit increase in public extension services causes a 0.244-unit improvement in sorghum production; all other factors are constant. All other variables remained constant; the availability of credit facilities has a 0.241units more sorghum production compared to zones without access to them. Private extension services, public extension services, and credit facilities significantly impact sorghum production,  $p < 0.05$ .

Table 14: Summary Regression coefficients

Variables	Unstandardized Coefficients		Standardized Coefficients	T	Sig.
	B <sub>0</sub>	Std. Error			
(Constant)	1.721	.200		8.586	<b>0.000*</b>
private extension	.072	.036	.112	2.036	<b>0.043*</b>
public extension	.244	.038	.357	6.441	<b>0.000*</b>
Credit facility availability	.241	.084	.154	2.868	<b>0.004*</b>

a. Dependent Variable: impact on sorghum production for improved food security

**\* means significant at 5% level of significance**

#### 4.6: Discussion

This chapter discusses the findings as per the objectives of the role of extension services on sorghum for improved food security.

#### **4.6.1 Socio-Demographic Characteristics**

From the study, most of the participants were from north Karachuonyo ward, 125(43.6%), 96(33.4%) of the participants were from west Rachuonyo ward and the remaining 23 percent were from Kibiri. More than 50 percent of the participants were of the female gender. About half of the sorghum farmers were married, 37.3 percent single and the rest were widowed, divorced or separated. More than 60 percent of the sorghum farmers were aged between 18-35years, 27 percent aged 36-55 years, and 11.1 percent were above 56 years. Participants had various levels of study; around 51.9% of them had some formal education whereas 48.1% had no formal education. Farming is a form of employment, 52.3% stated that they were unemployed, 22.3% employed themselves, 12.2% were employed, and student farmers were 10.8% and the retired being 2.4%.

#### **4.6.2 Impact of Private Extension on Improved Food Security**

Private extension services are among the services that are valued most compared to the public extension. The private sector provides farmers with farm inputs such as seeds, fertilizers and other farm products, advisory services regarding sorghum routine management practices as well as linking farmers to the market and researching on advanced technology farming to better farmers welfare. Sustainable food security is mostly influenced by introduction of modern technology by private extension, more than 86% of the participants agree with the statement. More than 80% of the participants believe that private training of farmers tends to lead to higher production hence improving food security. Private extensions provide farmers with farm inputs at subsidized costs as cited by 80.5% of the respondents.

#### **4.6.3 Contribution of Credit Facilities on Sorghum Productivity**

Credit organizations have a great impact on smallholder farmers since most of them are not able to fund their projects. However, credit organizations have got their own limitations and drawbacks (Mutua & Oyugi, 2016). Over 90% of the farmers depend on credit facilities for financing to access farm inputs such as fertilizers and seeds whereas 88% state that they have limited access to credit facilities due to various reasons.

The limitations to credit facilities cited by over 81% of the farmers are lack of security to act as a bank collateral to the facility, high repayment rates and unavailability of credit institutions within the

region. (Mutua & Oyugi, 2016) state that interest rates have increased hence lower income investors such as sorghum farmers are restricted hence cannot finance high return projects. The return from the project can also be equal to the interest charged by the banks hence unsuitable for improved sustainability. This study also supports (Okpara, 2014) that less than 20% of Africans have access to credit facilities due to poor transport and infrastructure as well as low population densities. Credit facilities however have a significant association with the location as seen from the chi-square test,  $p < 0.001$ . West Karachuonyo ward was observed to have more credit facilities compared to other wards. This may be attributed to factors such as good infrastructure and high population densities.

#### **4.6.4 Impact of Public Extension Services**

Public sector extension services, despite various challenges posed by private extension have managed to be of benefit to the farmers in west Karachuonyo. Over 80% of the respondents agree that public extension sector distribution of farm inputs, training farmers and introducing new farm technology has an impact on sorghum production for improved food production. Public extension training is offered through farmers field school or through visitation and training of farmers. However, the mode of training is associated with ward where the farmer comes from according to the chi square test performed,  $p < 0.001$ .

#### **4.6.5 Contribution of Private and Public Extension and Credit Facility Availability on Sorghum Production**

From the findings, private extension, public extension and credit facilities have a significant positive impact on sorghum production for improved food security. The impact of public extension services followed by credit facility and finally private extension. Public extension services are mostly embraced in north Karachuonyo than private extension services since it is the long serving knowledge disseminator and promotes adoption of modern technologies (Salami, Kamara, & Brixiova, 2010)

## **CHAPTER FIVE: SUMMARY, CONCLUSION AND RECOMMENDATION**

### **5.0: Introduction**

This chapter consists of summary, conclusion recommendations and suggestion for further research.

### **5.1: Summary**

From the findings, private extension, public extension and credit facilities have a significant positive impact on sorghum production for improved food security. Sorghum farming in Rachuonyo North Sub-County is dominated by 60% of the majority of adults aged between 18-35 years old. They have a vast of characteristics including possession of formal education and are considered to be at a prime farming age that has a potential of supplying farm labor that supports food productivity in the study area.

Both public and private extension plays a major role of supporting sorghum production. Of the two extension providers, private extension provider is the most valued extension service provider in the study area compared to their public counterpart. it has a positive influence on food security in the study area. Some of the services being provided by extension organizations to farmers include: provision of modern farming technology, giving farm inputs to farmers at a subsidized price and training of farmers.

For food sustainability among small holder farmers, credit is a crucial aspect. Most of these farmers are not able to fund their food production projects due to financial constraints. Over 90% of farmers depend on credit facilities to access farm inputs such as seeds and fertilizers. Therefore, availability of credit facility among farmers has a great influence on improved food security.

Public extension service providers have also had a great influence on improved food security despite the competition faced from private counter parts. The training offered through farmers field school (FFS) by public extension provider has also contributed to improved food security among small holder farmers in the study area.

### **5.2: Conclusion**

Fom the findings of the study, the following conclusion can be derived:

- i. Private extension services are among the services that are valued by sorghum farmers in the study area. This is attributed to the fact that they provide farmers with inputs such as fertilizers and seeds at subsidized price
- ii. Majority of the respondents agreed that food security sustainability can be improved through exposing farmers to modern farming technology.
- iii. Training farmers on new farming methods is needed as this can lead to increased food production hence improving food security sustainability in the study area
- iv. Credit facilities have a greater impact on small holder farmers since it has made it easier for them to access farm inputs more easily. However, majority of them cannot access credit facilities due to lack of security which may act as bank collateral of the facility.
- v. Public sector extension services, despite various challenges posed by private extension has managed to be of benefit to the farmers in Rachuonyo North Sub-county. Over 80% of the respondents agree that public extension sector distribution of farm inputs, training farmers and introducing new farm technology has an impact on sorghum production which has since improved food security.

### **5.3: Recommendations:**

From the findings and conclusion, the following recommendations were made:

- i. Both the county and national government should ensure that farmers in Rachuonyo North Sub-County are provided with affordable agricultural extension services in order to improve food production. Especially those who have never been exposed to it.
- ii. The county government of Homa Bay and financial institutions in the area should work closely and come up with measures that would ensure farmers are able to access credit facilities without facing any hindrances such as security requirement
- iii. The organizations providing extension education should emphasize more on exposing farmers to modern technology such as use of hybrid seeds.
- iv. Other than agricultural extension services, the government should partner with other international organization to find a quick solution to food insecurity.
- v. The county government of Homa Bay should increase funding on agricultural docket in order to facilitate food production in the region; this may include employment of more extension service officers, buying of agricultural equipment and inputs and then sell them to farmers at a subsidized price.

#### **5.4: Further research**

This study aimed at the assessment of the contribution of agricultural extension services on sorghum production for improved food security among the smallholder farmers in Rachuonyo North sub-county, Homa Bay county. However, this research could further be conducted focusing on the following areas:

1. Detailed study needs to be done on basic knowledge of agricultural extension education provided to sorghum farmers, methodology and how training programs are planned and administered to farmers.
2. More quantified study needs to be done on the influence of affordable agricultural extension on sorghum production for improved food security among small holder farmers.
3. Evaluation needs to be done on the impact of international organization partnering with county government on food security.

## REFERENCES

- Ahmadpour, A., & Soltani, S. (2014). The Need for a Strong Public-Private Linkage in Agricultural Extension System (Case Study: Sari Township, Iran). *International Journal of Agricultural Management and Development (IJAMAD)*.
- Alila, P. O., & Atieno, R. (2016). Agricultural Policy in Kenya: Issues and Processes.
- Beinah, A., Kunyanga, C., & Ngugi, K. (2020). Utilization and Processing of Sorghum by Small Holder Farmers in Drought Prone Agro-Ecological Zones of Kenya. *Advances in Social Sciences Research Journal*, 7(10).
- Benor, D., Baxter, M. W., Harrison, J. Q., & Bank, W. (2014). *Agricultural Extension: The Training and Visit System*. World Bank.
- Birch, I. (2018). *Agricultural productivity in Kenya*. K4D: Knowledge, Evidence and Learning for Development.
- Bitzer, V. (2016). Incentives for enhanced performance of agricultural extension systems . *Sustainable Economic Development and Gender*.
- Carozzi, M., Loubet, B., Acutis, M., Rana, G., & Ferrara, R. M. (2013). Inverse dispersion modelling highlights the efficiency of slurry injection to reduce ammonia losses by agriculture in the Po Valley (Italy). *Agricultural and Forest Meteorology*, 306-318.
- Charan, J., & Biswas, T. (2013). How to calculate sample size for different study designs in medical research? *Indian Journal of Psychological Medicine*, 35(2), 121-126.
- Chege, J. M., Lemba, J., & Semenye, P. P. (2018). Influence of Land Tenure on Food Security Status among Smallholder Farmers in Kilifi South Sub-County, Kenya.

- Christiansen, Swelam, Hill, Gasteyer, & Swanson. (2015). Evaluating Agricultural Extension and Advisory Services through a Governance Lens. *Journal of International Agricultural and Extension Education*.
- Davis, K., Nkonya, E., Kato, E., Mekonnen, D., Odendo, M., Miiro, R., & Nkuba, J. (2012). Impact of Farmer Field Schools on Agricultural Productivity and Poverty in East Africa. *World Development*, 40(2), 402-413. doi:<https://doi.org/10.1016/j.worlddev.2011.05.019>
- Demissie, T., Duku, C., Groot, A., Muhwanga, J., Nzoka, O., Recha, J., & Osumba, J. (2020). *Sorghum Kenya: Climate risk assessment. Climate Resilient Agribusiness for Tomorrow (CRAFT)*. CGIAR Research Program on Climate Change, Agriculture and Food Security. Retrieved from <https://ccafs.cgiar.org/resources/publications/sorghum-kenya-climate-risk-assessment>
- Elferink, M., & Schierhorn, F. (2016). Global Demand for Food Is Rising. Can We Meet It? *Harvard business review*.
- Fabregas, R., Kremer, M., Robinson, J., & Schilbach†, F. (2017). *The Effectiveness of Public Agricultural Extension: Evidence from Two Approaches in Kenya\**.
- FAO. (2009b ). *Expansion of Farmer Field Schools Programme in Eastern and Southern Africa: Project Findings and Recommendations: Africa Region: Kenya, Mozambique, Tanzania, Uganda*. Rome: Food and Agriculture Organization.
- FAO. (2014). *Food Loss Assessments: Causes and Solutions*. Rome: Food & Agriculture Organization of the United Nations.
- FAO/KARL/ILRI. (2003). *Farmer Field Schools: The Kenyan Experience”*, report of the Farmer Field School stakeholders' forum held on 27 March 2003 at ILRI,. Nairobi, Kenya.
- Fitzgibbon, C. (2012). *Economics of Resilience study – Kenya country report*. 25 ANLAP since 199-2022.
- Fuglie, K. O., & Rada, N. E. (2013). *Resources, Policies, and Agricultural Productivity in Sub-Saharan Africa* . Economic Research Report 145368, United States Department of Agriculture, Economic Research Service.

- Goddu, K. (2012). ). *Meeting the challenge: Teaching strategies for adult learners. Kappa Delta Pi Record, 48(4), 169-173.*
- GoK. (2010). *Agricultural Sector Development Strategy (ASDS) 2010–2020.* . Nairobi, Kenya: Government Printer.: Government of Kenya.
- GoK. (2012). *County Fact Sheets. Summary by the Kenya Commission on Revenue Allocation.* Government of Kenya (GoK).
- Grow intelligence .* (2015).
- Hosseyni, S., Khaledi, M., Ghorbani, M., & Brewin, D. (2012). An Analysis of Transaction Costs of Obtaining Credits in Rural Iran. *Journal of Agricultural Science and Technology.*
- IBP, I. ( (2017)). *Mexico Business Law Handbook Volume 1 Strategic Information and Basic Laws.*
- IBP, I. ( (2017)). *Mexico Business Law Handbook Volume 1 Strategic Information and Basic Laws.*
- J. Mbula, K. J. (2019). *Knowledge for Wealth Creation.*
- Kassam, A. H. (2017). *The common misconception among farmers regarding private extension services is that they are prohibitively expensive and unaffordable, but the reality is that they provide high-quality services since they are for-profit businesses.*
- Kimuyu, P., & Omiti, J. (2015). *Institutional impediments to access to credit by micro and small scale enterprises in Kenya.* Institute of Policy Analysis and Research.
- KNBS. (2016). *Kenya Integrated Household Budget Survey 2015-2016.* Nairobi, Kenya: Kenya National Bureau of Statistics.
- Korhonen., V. (2010). *Cross-cultural lifelong learning. Tampere University Press.*
- Kothari, R., & Gaurav. (2014). *Research Methodology, Methods and Techniques .*
- Labarthe, P., & Laurent, C. (2013). Privatization of agricultural extension services in the EU: Towards a lack of adequate knowledge for small-scale farms? *Food Policy, 38, 240-252.*  
doi:<https://doi.org/10.1016/j.foodpol.2012.10.005>
- Ministry, K. (2009). *Rachuonyo.*

- MoA. (2013). National Agricultural Sector Extension Policy (NASEP). *Ministry of Agriculture, Livestock & Fisheries*.
- MoA. (2014). National Agricultural Sector Extension Policy (NASEP). *Ministry of Agriculture, Livestock & Fisheries*.
- MoALF. (2016). *Climate Risk Profile for Homa Bay County. Kenya County Climate Risk Profile Series*. Nairobi, Kenya: The Ministry of Agriculture, Livestock and Fisheries (MoALF). Retrieved from <https://ccafs.cgiar.org/resources/publications/climate-risk-profile-homa-bay-county-kenya-county-climate-risk-profile>
- Moghaddasi, M., Morid, S., Delavar, M., & Hossaini Safa, H. (2017). Lake Urmia Basin Drought Risk Management: A Trade-Off Between Environment and Agriculture. *Irrigation and Drainage*, 66(3), 439-450.
- Mugenda, M. a. (2003). *Research Methods: Quantitative and Qualitative Approaches*. Nairobi: African Centre for Technology Studies (ACTS) Press, Nairobi.
- Musa, Y., Aboki, E., & Audu, I. (2013). The Limitations and implications of Training and Visit (T&V) Extension System in Nigeria. *Journal of Agriculture and Sustainability*.
- Mutua, J. M., & Oyugi, L. N. (2016). *Access to financial services and poverty reduction in rural Kenya*.
- Mwadalu, R., & Mwangi, M. (2013). The potential role of sorghum in enhancing food security in semi-arid eastern Kenya: A review. *Journal of Applied Biosciences*.
- Ngode, A. Q., Ng'eno, K. E., & Anjichi, V. (2021). Farm Production Factors Affecting Malt Sorghum Production among Contracted Sorghum Farmers in Homa Bay County, Kenya. *African Journal of Education, Science and Technology*, 6(4), 144-153. Retrieved from <https://ajest.info/index.php/ajest/article/view/724>
- Njagi, T. O. (2019). The potential role of sorghum in enhancing food security in semi-arid eastern Kenya: A review. *Journal of ApSorghum production in Kenya: Farm-level characteristics, constraints and opportunities. Tegemeo Institute.plied Biosciences*, 71, 5786-5799.

- Okati, M., Ahmadpour, M. B., & Sarani, V. (2021). Recognizing the factors affecting on food security in rural areas (Case study of villages in Zahak region in Sistan and Baluchestan province). *Journal of Rural Development Strategies*.
- Okpara, J. O. (2014). Factors Constraining the Growth and Survival of SMEs in Nigeria. *Implications for Poverty Alleviation*.
- Okuthe, I. K. ((2013)). *The influence of institutional factors on the adoption of improved sorghum varieties and technologies by smallholder farmers in Western Kenya. Int J Humanit Soc Sci, 3, 196-207.*
- Onono, P. (2018). Response of Sorghum Production in Kenya to Prices and Public Investments. *Sustainable Agriculture Research, 7. doi:10.5539/sar.v7n2p19*
- Orr, A. M. ((2016).). *Sorghum and millets in Eastern and Southern Africa: facts, trends and outlook.*
- Osano, H. M., & Languitone, H. (2016). Factors influencing access to finance by SMEs in Mozambique: case of SMEs in Maputo central business district. *Journal of Innovation and Entrepreneurship*.
- Pirmoradi, A. (2013). Private extension: functions and duties. *Journal of American Science*.
- Pius, W., & Chang'ach, J. K. (2013). *Education Reforms in Kenya for Innovation*.
- Republic of Kenya. (2012). *Republic of Kenya* .
- Rivera, W. M., Zipp, W., & Alex, G. (2012). *Good practices in contracting for extension*. CABI.
- Salami, A., Kamara, A. B., & Brixiova, Z. (2010). *Smallholder Agriculture in East Africa: Trends, Constraints and Opportunities*. Tunis, Tunisia: Working Papers Series N° 105 African Development Bank.
- Sikei, G. O. (2009). *he Role and Performance of the Ministry of Agriculture in Rachuonyo District. Future Agricultures Research Paper 016*.
- Stathers, T. L. ((2013). ). *Postharvest agriculture in changing climates: its importance to African smallholder farmers. Food Security*.

- Taylor, B. &. (2009). *Andragogy's transition into the future: Meta-analysis of andragogy and its search for a measurable instrument. Journal of adult education, 38(1), 1-11.*
- Teklu., H. W. (2011). *Smallholder Farmers Access to Agricultural Credit and Its Impact. LAP Lambert Academic Publishing.*
- Van Niekerk, J., Stroebel, A., Whitfield, K., Swanepoel, F., & Van Rooyen, C. (2014). Towards Redesigning the Agricultural extension service in South Africa: Views and proposals of smallholder farmers in the Estern Cape. *South African Journal of Agricultural Extension.*
- Van Wijk, J., & Kwakkenbos, H. (2013). *Beer multinationals supporting Africa's development?*
- Waddington, H., Snilstveit, B., Hombrados, J., Vojtkova, M., Phillips, D., Davies, P., & White, H. (2014). Farmer Field Schools for Improving Farming Practices and Farmer Outcomes: A Systematic Review. *Campbell Systematic Review.* doi:10.4073/CSR.2014.6
- Wanigasundera, W., & Atapattu, N. (2019). Extension reforms in Sri Lanka: lessons and policy options. In E. a. Suresh Chandra Babu, *Agricultural Extension Reforms in South Asia, 2019.* ACADEMIC PRESS.
- WFP. (2015). *Kenya Food Security and Outcome and Monitoring (FSOM), Consolidated report, WFP.* World Food Program.
- WFP. (2016). *Kenya - Food Security and Outcome Monitoring, 2016.* Nairobi: World Food Programme.
- WFP. (2016). *Zero Hunger: the Heart of the 2030 Agenda.* World Food Programme.
- World Bank. (2012).
- World Bank; CIAT. (2015). *Climate-Smart Agriculture in Kenya. CSA Country Profiles for Africa, Asia, and Latin America and the Caribbean Series.* Washington D.C.: The World Bank Group. Retrieved from: Retrieved from <https://cgspace.cgiar.org/handle/10568/69545>

## APPENDICES

### Appendix 1: Questionnaire

**JARAMOGI OGINGA ODINGA UNIVERSITY OF SCIENCE AND TECHNOLOGY**

**ASSESSMENT OF THE CONTRIBUTION OF AGRICULTURAL EXTENSION SERVICES  
ON SORGHUM PRODUCTION FOR IMPROVED FOOD SECURITY AMONG SMALL  
HOLDER FARMERS**

**RESEARCH CONDUCTED BY:**

**ABEL AWITI OPEE**

**CELL:+254705555640**

**EMAIL:awitiabel@gmail.com**

**Dear Respondent**

I am a post graduate student at Jaramogi Oginga Odinga University of Science and Technology, Reg No: A352/4066/2019. This is to kindly request you to assist me with the information as desired in this questionnaire towards a research survey on the assessment of agricultural extension services on sorghum production for improved food security among small holder farmers in Rachuonyo North Sub –County in Homa Bay County. All the information provided will be used for academic purposes and will be treated with the privacy and confidentiality it deserves accordingly. Thank you.

Date \_\_\_\_\_

Ward \_\_\_\_\_

### INSTRUCTIONS

- **Every response will be treated with utmost confidentiality**
- **Tick within the appropriate boxes**
- **Write the explanation clearly**
- **Do not write your name**
- **Do not write the organization's/institution's name**

### SECTION A:

#### DEMOGRAPHIC CHARACTERISTICS OF RESPONDENTS

1. Gender:

Male  Female

2. Civil status:

Married  Single  Widowed  Divorced  Separated

3. Age bracket:

18-25yrs  26-35yrs  36-45yrs.  46-45  56-65yrs  66Yrs and above  
 Other (specify)

4. Level of education:

Primary school  Secondary school  Certificate  Diploma  
 Undergraduate  Post Graduate  Other (specify)

**SECTION B:**

**CONTRIBUTION OF PRIVATE EXTENSION SERVICE PROVIDER ON SORGHUM PRODUCTION FOR IMPROVED FOOD SECURITY**

1. To what extent do you agree with the following statements on a scale of 1-5; where 1-Very Low extent,2-Low extent,3-Don't Know 4-High Extent and 5-Very High Extent. Kindly tick on the table below according to your degree of satisfaction.

Aspects of private extension involvement	1	2	3	4	5
a) Introduction of modern technology by private extension on sorghum farming influences sustainability of food security					
b) Providing sorghum farmers with the farm inputs on a subsidized price improves food security.					
c) Training of sorghum farmers by private extension providers improves food security					

2. How would you rate your interest in private extension training to farmers? Tick in the appropriate box.

	<b>Not interested</b>	<b>Slightly interested</b>	<b>Moderately interested</b>	<b>Very interested</b>
<b>Ranking</b>	1	2	3	4
<b>Interested in training</b>				

3. What major challenges have you faced when accessing private agricultural extension services?

.....  
 .....  
 .....

4. What was the major reason why you decided to seek for private agricultural extension services other than any other extension provider?

.....  
 .....

**SECTION C:**

**INFLUENCE OF CREDIT FACILITY ON SORGHUM PRODUCTION FOR IMPROVED FOOD SECURITY**

5. To what extent do you agree with the following statements on a scale of 1-5;where 1-Very Low extent,2-Low extent,3-Don't Know 4-High Extent and 5-Very High Extent. Kindly tick on the table below according to your degree of satisfaction

Aspects of financial capacity	1	2	3	3	5
a) Accessing farm inputs such as seeds and fertilizers on credit basis is necessary for sustainability of sorghum production.					
b)Small holder sorghum farmers have limited access to credit facilities due to terms and condition stipulated by credit agencies					

6. How would you rate the need of credit facility in sorghum farming? Tick in the appropriate box

	Not needed	Least needed	Needed	Really needed
Ranking	1	2	3	4
Need for credit facility				

7.Do you know the number of available organizations providing credit in this place?  Yes  No

8. If yes how many number of organizations are available?  <10  10-20  30-40  >40

9. What reasons do you have that prevents you from getting the desired amount of credit. Tick appropriately.

- Lack of security requirement [ ]
- High repayment rate [ ]
- Unavailability of credit institutions [ ]

10. How has credit facility helped you improve on your sorghum production?

.....

.....

.....

**SECTION D:**

**3. CONTRIBUTION OF PUBLIC AGRICULTURAL EXTENSION ORGANISATION INVOLVEMENT IN SORGHUM PRODUCTION FOR IMPROVED FOOD SECURITY AMONG SMALL HOLDER FARMERS**

11. How best would you describe the visit of farmers by public extension officers in this area? Tick in the appropriate box.

	<b>Not frequent</b>	<b>A little frequent</b>	<b>Frequent</b>	<b>Very frequent</b>
<b>Ranking</b>	<b>1</b>	<b>2</b>	<b>3</b>	<b>4</b>
<b>Visitation made</b>				

12. To what extent do you agree with the following statements on a scale of 1-5; where 1-Very Low extent,2-Low extent,3-Don't Know 4-High Extent and 5-Very High Extent. Kindly tick on the table below according to your degree of satisfaction.

<b>Aspect of private sector</b>	1	2	3	4	5
a) Public sector distribution of farm inputs to sorghum farmers influences food security					
b) Training of sorghum farmers by private extension leads to improved food security.					
c)Introduction of new farming technology by private sector leads to improved productivity of sorghum crop in the area					

13. Through which method does public agricultural extension provider use to train sorghum farmers in the area?

[ ] Farmers field school [ ] Training and Visit.

14. How would you rate nature of impact that public agricultural extension provider can have on sorghum production in the area?

	<b>No impact</b>	<b>Least impact</b>	<b>Fair impact</b>	<b>Great impact</b>
<b>Ranking</b>	1	2	2	4
<b>Impact</b>				

Appendix 2: Map of Study Area



**Appendix 3: ERC Approval Letter**



## Appendix 4: Acknowledgment For Publication Process

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We are glad to find you interested in our journal. We are acknowledging the receipt of paper under '**February Issue, 2024**'. We are attributing a unique Paper ID- **HS2402-004** which is needed for further reference. Your paper is under review. We will get back to you very soon.

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2. **Name of Author 1**  
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3. **Name of Author 2**  
Prof Obel Gor
4. **Name of Author 3**  
Dr(PhD) Walter Akuno
5. **Name of Rest of the Authors (Comma Seperated)**  
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to me, abelopee

Dear Author,

Greetings!!!

This is to inform you that after a rigorous review process, our review panel has reached a decision about your paper!

Your paper titled "Assessment of the Contribution of Agricultural Extension Services on Sorghum Production for Improved Food Security among Smallholder Farmers in Rachuonyo North Sub-County, Homa Bay County, Kenya" (Paper Id - **HS2402-004**) has been accepted for publication in the 'February Issue, 2024' (*Vol 12 Issue 2*) of "The IJHSS". Please deposit your publication fee for the further process of your paper.

**Details of Publication Fee:**

1. Amount: \$70 (excluding transaction charges)
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3. Due Date: **13th February, 2024**
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For credit to	Account Number	11427374
	ICICI BANK SWIFT CODE	ICICINBBCTS
	ABA FED No	21000021
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