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Faculty of Natural Resources and Agricultural Sciences

Can Smartphones be used as an information delivery tool in post-conflict context?

- Exploring possibilities of using smartphones to deliver agricultural advisory services in Afgooye district -Somalia

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Can Smartphones be used as an information delivery tool in post-conflict context?

Exploring possibilities of using smartphones to deliver agricultural advisory services in Afgooye district -Somalia

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Abstract

In areas where reaching out to rural farmers is difficult, Information and Communication Technologies (ICTs), such as mobile smartphones may offer an opportunity to share timely information on weather, markets, farm inputs, and research results to the farmers. Access to this type of information could potentially enhance farmers' farm productivity and their ability to make crucial decisions related to farm management in the face of climate variability. Mobile technologies have been identified as one way of easing information communication with farmers, especially in remote hard to reach areas.

As in most African counties, the mobile technology sector is the leader in ICT development in Somalia, with approximately 7 out of 10 Somalis using mobile money services regularly. This creates and provides an opportunity for communicating and delivering information to farmers using ICTs technologies. What is not well understood is how ICTs, particularly smartphones, could be used as an information communication tool in post-conflict areas like rural Somalia. This study set out to assess the feasibility of using smartphones as a tool for delivering agricultural advisory information to rural farmers in the Afgooye district of Somalia.

During a period of 11 weeks between December 2018 to March 2019, interviews were conducted with 30 vegetable growers and ten key informants. Individual interviews were carried out with the key-informants, while semi-structured questionnaire interviews were conducted with the farmers.

The findings of the study revealed that the necessary enabling conditions for the adoption and implementation of the smartphone-based advisory system in the study area exist. Moreover, the use of smartphones among surveyed vegetable growers was influenced by factors like age, literacy level, and non-farm income source. Growers that had land title deeds, as well as non-farm income, were more likely to own a smartphone or to buy one compared with other farmers who rented land or shared their farmland. Furthermore, human security issues, as well as internet connectivity, were the main factors that constrain the access and use of smartphones in the Afgooye area. Mobile data cost was another factor stated by the farmers as restricting the optimal use of smartphones.

The main conclusion of this study is that while there is a potential of using smartphones in the study area as an information delivery tool, there are both internal and external challenges that need to be improved. Specifically, many of the farmers identified security and credible information source providers as more urgent issues. Somalia is in the process of post-conflict construction, therefore, peace and security continues to be threatened by a range of external forces.

Keywords:

Agricultural advisory service, Farmers, Information and communication technology, Post-conflict, Security, Smartphone, Vegetables, Somalia.

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LIST OF ABBREVIATIONS

FAO	Food and Agriculture Organization.
ICT	Information and Communication Technology
FSNU	Food Security and Nutrition Analysis Unit-Somalia.
SWALIM	Somalia Water and Land Information Management
UNDP	United Nations development program
IUSS	International Union for Soil Sciences
CTA	Technical center for agriculture and rural cooperation
Bsh	Sub Tropical Stepe climate
JILAL	Dry season (December-March)
GU	Long rainy season (April - June)
HAGA	Dry Season (July to September)
DAYR	Short rainy season (October to November)
LGB	Length of Growing Period
RH	Relative Humidity
GDP	Gross Domestic Product
TAM	Technology acceptance model
TTF	Task technology fit
GB	Gigabyte

In the report, Somali spelling has been used for the Study area names.

Somali	English
Afgooye	Afgoi
Muqdisho	Mogadishu

1. Introduction

Modern information and communication technologies such as mobile phones, TVs, Radios are very useful in agricultural advisory services. In developing countries where reaching out to rural farmers is difficult, ICTs technologies may offer an opportunity to share relevant agricultural advisory services that rural farmers needed to do farming activities in a sustainable way (Janssen, et al., 2017).

Agriculture advisory services play an essential role in improving the economic and social development of the country (Deichmann, et al., 2016).To increase production in areas where small scale farmers dominate, transfer of knowledge and information sharing through agricultural advisory services is essential.

Agriculture is the backbone of Somalia's economy, and its performance has a significant impact on the livelihood of the population. Although Somalia is a country with unprecedented opportunities in agricultural areas, the country has been struggling for years with serious food security problems, long-lasting civil wars, and from time to time, climatic disasters that have reinforced the problem of food shortage (Maxwell & Fitzpatrick, 2012).

Recently, food insecurity has been an increasingly important topic amongst national decision-makers due to the country's low food production and dependency on food aid (Devereux, 2018). Small scale farmers produce most of the country’s food.

With the help of ICTs technology, farmers could have access to agricultural advisory services and receive necessary information regarding farm management, inputs, and market information as this will enhance farm productivity and their ability to make crucial decisions related to farm management in the face of climate variability (Kumar & Ratnakar, 2016).

The mobile sector is the leader in ICT development in Somalia. Private mobile companies using cellular technology provides wireless Internet access through cell phones. Mobile phone usage is increasing in Somalia (World Bank, 2018), and people use mobile phones for a variety of purposes; for instance, mobile

payment is becoming common in Somalia. According to (World Bank, 2018), the mobile penetration rate in Somalia is the leader in the region, and approximately 7 out of 10 Somalis use mobile money services regularly. Since the technology is there, the use of ICT based advisory method could bring benefits to the Somali farmers.

There are various ways to deliver advisory services to farmers through ICTs technology (Munthali, et al., 2018). However, from a farmer's perspective, they prefer a technology they already have like mobile phones and understand how to use, to assess the feasibility of using smartphones as a tool for delivering agricultural advisory services in Afgooye district, this study was carried out.

The study area (Afgooye district) is one of the most crucial horticultural production areas in Somalia (FSNAU, 2013). The district is located 30 km west of the capital and provides most of the vegetables consumed in the capital.

This study has looked from a vegetable growers' perspective on using Smartphones as a tool for delivering agricultural advisory services and their preferred method of information delivery. Vegetable growers were focused since almost all farmers in this region grow one or more vegetable crops because of its short growing period, and it is a relatively higher market price than other crops (Jimale, 2016).

1.1. Background Information

Somalia is located in the horn of Africa. It borders with Kenya in the southwest, Djibouti to the northwest, and Ethiopia to the west. Mogadishu is the capital of the country. The country's land area is estimated to 637,660 km2, and it has the longest coastline (the Indian Ocean and the Red Sea) in Africa of about 3.330 km (Sommer & Schneider, 1996).

Somalia has arid to a semi-arid environment, which is suitable for the nomadic pastoralist. However, the southern part of the country is more fertile and wet, caused by the presence of two rivers (Shebelle and Jubba). This region is also known for its lower temperatures, which vary from 20 till 30 °C whereas in the north temperatures of 30 till 40 °C is standard.

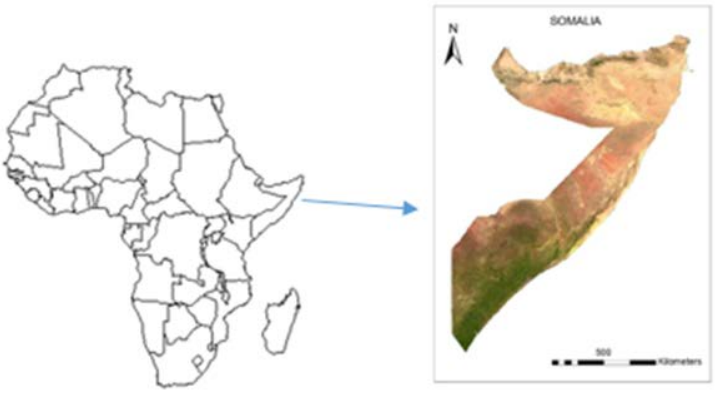


Figure 1 Map of Africa showing the location of Somalia

In general, agriculture (Livestock, Crops, Fishing, and Forestry) in Somalia is the backbone of the Somali economy (World Bank, 2015) The sector contributes to the Somalia economy by 60% (FSNAU, 2013). Although livestock production is the backbone of Somalia agriculture, crop production-based system ranks second place (Majid & McDowell, 2012). Due to a lack of recent GDP data, the share of vegetable sub-sector in the Somalia economy at present is not known.

1.2. Problem statement

Factors like fragile security, poor agricultural infrastructure, weak institutional capacity, and vulnerability to droughts are holding back the development of agriculture in Somalia (Devereux, 2018). In 1991, when the Somalia central government collapsed, a civil war broke out, there was a severe deterioration of the country's agricultural infrastructure and the government institutions like the Ministry of agriculture were total absent until the early 2010s, and the farmers have been using some informal mechanism to access the information they need.

Currently, Somalia is in a complicated post-conflict reconstruction stage, and the institutional capacity of the Ministry of agriculture is weak, and the Ministry's inability to put crucial information in the hands of the farmers is hindering the farming development in the study area. This knowledge gap caused by a lack of advisory services, sustainable use of farm inputs is lacking, and as a result, low crop yield is common in the study area (Jimale, 2016). Access to knowledge, including market information, will help the farmers to choose the right crops to grow and careful management of natural resources on which they depend on.

Furthermore, reaching out to rural farmers through extension agents is seen inefficient, and it is both costly and time-consuming (Allahyaria, et al., 2018). Countries that are in a post-conflict situation like Somalia, where there are not enough resources for public advisory systems, finding another information delivery method where farmers could have access to advisory information is seen very vital, and acknowledgment of this inspires this thesis.

The growth of the ICT sector in Somalia offers new opportunities to provide low cost and timely advisory information to the farmers. Furthermore, the world is becoming more and more digitalized; the agricultural data production has increased in the last few years, especially as a result of climate change modeling (El Bilali & Allahyari, 2018). By turning these data into a simple practical solution that can be easily used by the farmer and deliver them through a technology the farmers already have and understand how to use, opens up a chance for using smartphones as information delivery tool that could be innovative solutions for the lack of the advisory information in the study area.

For farmers to get empowered and make the right decisions in their fields, it is necessary to provide them credible information about markets and support advisory service on-farm management. This study explores to see the feasibility of using smartphones for the delivery of information to the farmers in the Afgooye district, Somalia.

1.3. Aim of the research

The main objective of this study was to explore smartphone usage and adoption among vegetable growers in the Afgooye district.

Specific objectives.

- To assess the feasibility of using smartphones as a tool for delivering information to vegetable farmers in the study area.
- To get a deeper understanding of smartphone adoption among vegetable growers in Afgooye area.
- To find out the information needs of the vegetable growers in Afgooye and their preferred methods of delivery.

1.4. Research questions

The thesis addresses the following specific questions:

1. How feasible is it to use a smartphone when addressing the information needs of vegetable growers in post-conflict rural Afgooye?

2. What are the key factors influencing smartphone adoption among vegetable growers in Afgooye District?

3. What are the determinants that facilitate or constrain the access and the use of smartphones in post-conflict rural Afgooye?

4. What type of information do the vegetable growers in Afgooye need?

1.5. Study area

Afgooye district is one of the most important agricultural production areas in Somalia (FSNAU, 2013). According to the 2014 census of Somalia, the total population of the Afgooye district was about 238 655 (UNFPA, 2014). The region lies west of Mogadishu and provides most of the vegetables consumed in the capital (detailed map of the region can be found in Appendix 1). Although figures of actual area production are lacking, the potential of producing high-quality vegetables is there, with the proper knowledge and technology (USAID, 2014). The study area is more fertile and wet because of the presence of the Shebelle River.

According to the Köppen-Geiger climate classification, Afgooye district is classified as Tropical and Subtropical Steppe (M.C., et al., 2007), and the main characteristic of this zone is the annual evaporation is higher than the participation. The rainfall varies year to year basis in this region. The annual participation of the region is between 350 to 700 mm ((Venema, 2017). The annual average temperature of the area is always above 18°C.

In the province where Afgooye district located, areas close to the Shebelle River have relatively higher humidity 70 to 80% (Vargas, et al., 2017) at the beginning of the GU season.

As figure 2 shows, the average accumulated amount of rainfall of the Gu season in Afgooye (April to July) reaches up to 300 mm. This represents around 60% of the total annual participation of that area. Furthermore, the Hagai season is less significant compared with the Gu season, and they are less reliable too (Jimale, 2016). The participation amount of rain in the wet season is lower than the potential evapotranspiration (PET), as figure 2 shows, irrigation is needed in order to prevent crop water stress.

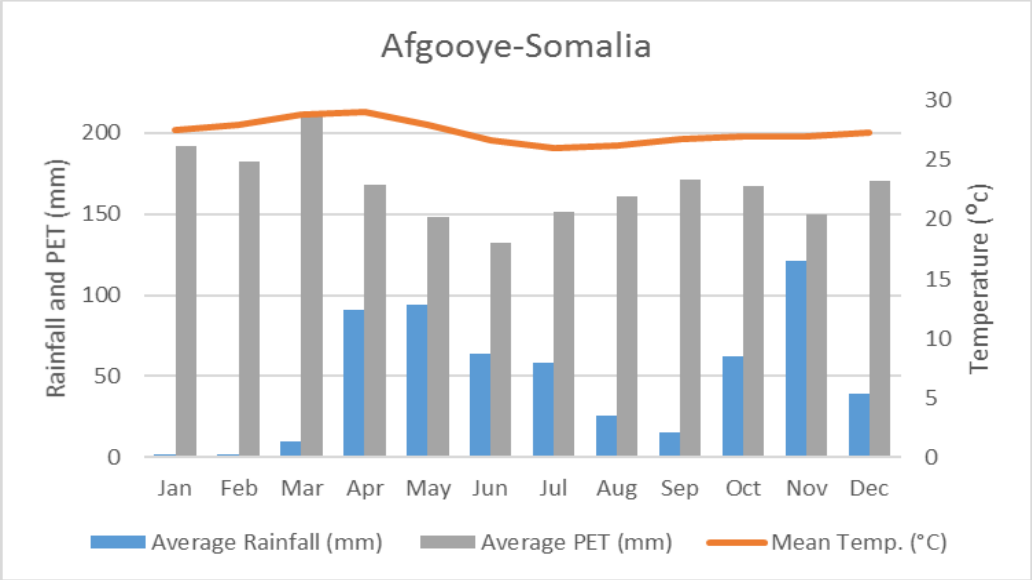


Figure 2 Distribution of Rainfall, Potential Evotranspritation and temperature in Afgooye- Somalia. Data source: FSNAU

The average annual temperature in the region is around 27 degrees Celsius. The temperatures variability throughout the year is low, with April being the hottest month in the region (~29 °C) while coldest temperatures in July (~26 °C).

The length of the growing period or season concept is very important since crops need a minimum period to finish their life cycle. The LGP, as defined by (FOA, 1978) is the period (expressed in days) during the year when rainfall exceeds ½ of the potential evapotranspiration (PET), (De Pauw, 1996).

According (FAO-SWALIM, 2007), the length of the growing period in Gu (April to June) and Dayr (October to November) season in Lower Shebelle region are respectively 90-119 days and 30-59 days.

The common soils type identified in the study area according to soil map developed by FOA-SWALIM are Vertisols, Cambisols, and Fluvisols. Unfortunately, their percentage distribution in the study area was not found. Details about the major soils in Somalia can be found in the report of Venema (2007).

At present, the farming system in the Afgooye district focuses mainly on self-subsistence farming (FSNAU, 2013). Most of the vegetable growers are alongside the Shebelle River and areas far from the river, grow vegetables in the rainy season. Farmers in the study area produce vegetables in a conventional method, meaning they are using chemicals when it comes to pest and disease control. Moreover, farmers in the study area practice traditional farming techniques. These methods are more labor-intensive, a great deal of physical work, and produce lower yield at the end (Jimale, 2016) .

1.6. Study scope and limitation

The scope of this thesis is limited to opinions of the surveyed vegetable growers on using ICTs in general and smartphones in particular as a tool for delivering agricultural information in the Afgooye district. In addition to that, the context of the actors that could potentially constitute a smartphone-based advisory information system in the study area was also explored.

Restricting this study to the use of a smartphone is a limitation to itself since all the growers in the study area could not afford to buy a smartphone. Bearing that in mind, this study targets a specific socio-economic class of farmers that are involved in vegetable production and have access to a smartphone with internet access.

In addition to that, the study will inform the local agricultural institutions and international development organizations working with Somali farmers that smartphones can be used as a communication tool for real-time information delivery to the farmers in the Somalia context.

Furthermore, the research was limited by a number of factors, mainly the availability of resources and time. There was a limitation in the finding on written sources for this study, although this was not strange given the fact that Somalia is at war for more than 25 years. What is remarkable is the resilience of the people of the country, making this study possible to be undertaken. I hope the information that this study generated will fill the literature research gap that exists in the study area context.

1.7. Thesis outline

This thesis report contains six main chapters. The first chapter contains the introduction as well as the aim and the problem statement of the research, and it also outlines the main research questions. The second chapter presents the contextual information about the study, while the third chapter deals with the way the research data was collected. The fourth chapter is about the findings of the study. Finally, the fifth and sixth chapter outlines the conclusion and discussion of the study.

2. Context Background

2.1. Contextualization of the study

For farmers to get empowered and make the right decisions in their fields, it is necessary to provide them credible information about markets and support advisory service on-farm management (Garforth, et al., 2003). In developing countries, agricultural Advisory is the most common program used to transfer agricultural information to the farmers, often the country's agricultural institutions are responsible for the Advisory program at the national level (Davis, et al., 2012) . Advisory service is a term often used as a replacement for extension service, and it means the same thing (Murari, 2011).

The agricultural advisory system context in which government advisory organizations work can be summed up under two main factors, which are the institutional factors and macro-environment factors (political, economic, socio-cultural, and Agroecological) (Peterson, 2006). These two main factors influence the flow of information between the advisory information providers and the farmers.

In the post-conflict context, farmers have limited access to advisory service since the agricultural institutions that supposed to provide the service are either not in place or a capacity-building stage (Kelly, 2013). In the context of Somalia, the nation's agricultural institution has been absent from 1991 until the early 2010s due to prolonged civil war (Gaas, 2018).

The agricultural advisory system plays a vital role in post-conflict agricultural development (Bourne, et al., 2017), and the country has been investing and rebuilding its institutions since the 2010s, and now the agricultural institutions of the country are operational. However, since the country is still in the post-conflict period, the surrounding macro-environmental factors of the nation's agricultural institutions make the task of information delivery to the farmers through extension agents extremely difficult.

Although the purpose of this study is not to analyze the causes and the nature of the Somali conflict, however, several factors caused the Somalia civil war. The

civil war resulted in an enormous distraction to the country's infrastructure; it damaged the agricultural institutions and destroyed the economic development of the country. Somalis are an agrarian society; the agricultural development and country’s stability are linked. When agriculture production fails, it usually leads to increased poverty and food insecurity, which tend to facilitate conflicts (Collier, 2003).

In order to contextualize the topic of this study, a system thinking approach was used. In this case study, the lack of information is the result of a combination of many social, economic, political, and environmental factors that all interact with one another. Relying on simple linear cause and effect solutions for the problem would ignore those interactions, and it will likely fail (Dettmer, 2007). Figure 3 shows a system context map that is used to contextualize the agricultural advisory information system in the study area.

System thinking is a way of looking at and understanding the complex situations in a holistic manner. It encourages us to explore the interactions and linkages between the elements that comprise the whole of the system. It is characterized by a belief that the parts of the system are intimately interconnected, and the parts of a system function differently when isolated from the system’s environment (Schiere, et al., 2004).

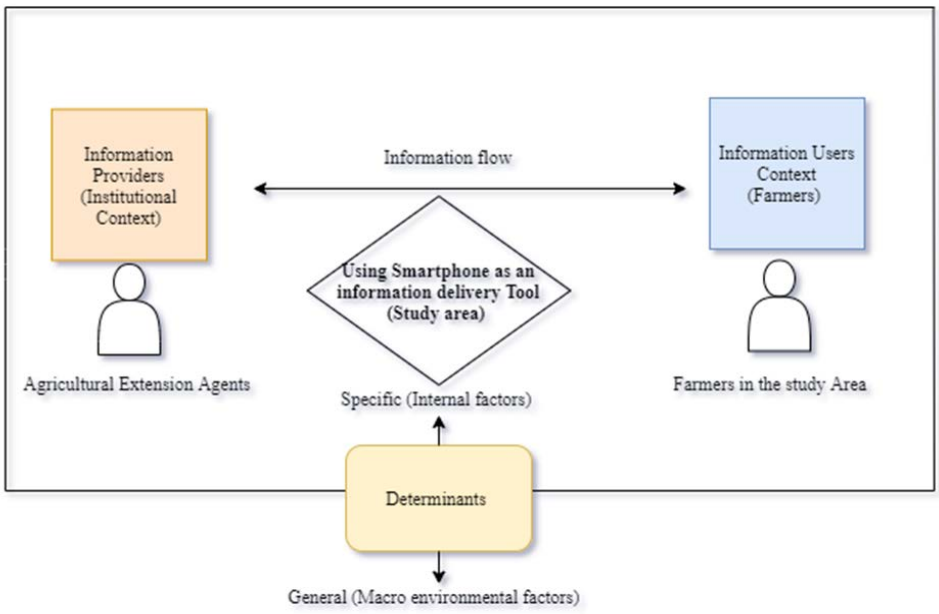


Figure 3 System Context Map

In addition to that, the system approach holds the most promise for addressing complex agricultural production issues like lack of advisory service (Schiere, et al., 2004).

As figure 3 shows, the agricultural information system in the study area consists of three main components set in a post-conflict context. The first component of the system is the information providers; in this case, the country's agricultural institution is responsible for that, and the context of these actors need to be searched. The second component in the system is the type of agricultural information delivery method used since the generated advisory information needs to be delivered to farmers in order to utilize it. Lack of information is an issue in Afgooye farmers, in order to address this problem, this study proposed to use a smartphone as an information delivery tool in the study area. The external and internal factors that could influence the use and adoption of the smartphone as an information delivery tool in the study area context need to be explored. Thirdly, the context of the information users (vegetable growers) has to be surveyed in order to identify their information needs.

Furthermore, the actors that constitute the advisory information system in the study area, as well as other external factors in the system influence each other in complex ways (Peterson, 2006) . Using a system perspective is essential, and it helps to understand better what facilitates or hinders the success of smartphone usage in information delivery to the farmers.

The rest of the chapter proceeds as follows. The first section gives an overview of the main agricultural information delivery methods used by different agricultural advisory providers. In Section Two, the past status of the country's agricultural advisory institution is presented to have a better understanding of the institutional context of the advisory providers in the study area before the civil war. The third section identifies the potential role that ICT in general and smartphones, in particular, could play when it comes to farmers' access to advisory information and the conditions that must exist for the use of the smartphone as an information delivery tool. Finally, the conceptual framework that is used for the study is presented.

2.2. Agricultural Information Delivery Approaches

The primary function of the agricultural advisory is to enhance the knowledge of the farmers by communicating them with agricultural research findings, improved farming practices, efficient technologies, and other things they need to know in order to increase their food production efficiency (Von Blanckenburg, 1982).

The concept and the objective of the advisory service have changed over time, and its definition has evolved over the last decades, and each definition is a product of its time. FAO (1978) defines agricultural advisory as *"a service or system which assists farm people, through educational procedures, in improving farming methods and techniques, increasing production efficiency and income, bettering their levels of living, and lifting the social and educational standards of the rural life*." (Gaaya, 1994).

There are several agricultural advisory methods used in the last decades, and the interest of advisory service increased towards improving its effectiveness in agriculture and rural development. The goal of advisory service in the 70s and 80s was to reach many small-scale farmers with limited resources and workforce (Axinn, 1998). The details about the main agricultural advisory approaches used in that period can be found in George Axinn's guide on alternative advisory approaches (Axinn, 1988). According to (Axinn, 1988), *"the word approach refers to the style of action within an advisory system."*.

There are things that these agricultural advisory approaches were in common, all of them employ non-formal education strategies, their content is related to agriculture, and finally, their primary purpose was to improve the livelihood of the rural people.

Some agricultural advisory approaches are controlled and directed at the state level while others were directed and controlled locally. Their strategies varied, some approaches focused more on technology transfer or development of rural people. However, since the advisory approaches were practiced over the years,

some approaches were more effective than others under area circumstances (Alex, et al., 2000).

During the 1990s, there was a global change in agricultural advisory thinking. Attention was given more on poverty alleviation through market-oriented agriculture. New ways of food production system emerged, the focus shifted from only achieving food security, countries become concerned about the depletion of their natural resource and the priorities were given the sustainable management of the environment and natural resources through the efficient use of land and water resources (Hall, et al., 2004).

Nowadays, it becomes apparent that the value of the information to the farmers, the governments are no longer the only source of information, and now private sectors provide information to the farmers in exchange for money. The ICT technology has created new opportunities in agricultural advisory, and now service can be delivered in ways that were not realistic before (Hamad, et al., 2018).

2.3. The context of agricultural advisory services before the civil war

The beginning of agricultural advisory in Somalia was in 1954 under a joint of the Italian-Somali Government scheme. The first advisory agricultural research station was initiated at Bonka Research station In Baidoa (Chapman, 1987). After Somalia claimed its sovereignty in 1960, several agriculture advisory centers were established at lower juba, lower Shebelle, and Hargeisa. The focus of these advisory centers was the promotion of cash crops like banana and citrus (Communities, 1975).

At the beginning of the 1970s, large irrigation schemes were developed along Shebelle and Juba rivers by the Somali government; the main objective behind was to move the country towards self-sufficiency with regards to food security (Webersik, 2005) and assist farmers in improving their livelihoods. The

agriculture advisory methods used in that period was through village meetings under a program called ‘Agraria Propaganda’ (Chapman, 1987).

The department of agriculture extension and production was established in 1980, and the agricultural advisory program was implemented in 11 provinces and 57 agricultural districts. The purpose of the department was to improve the knowledge of the farmers, by communicating them with the research findings, improved farming practices, and other things they need to know (Abukar, 2019).

However, the components of agriculture advisory received complete attention at the end of 1980 when a project called Agricultural Farm Management and Advisory Training Project (AFMET) was bought into effect. The project was funded by the African Development Bank, International Development Association, and USAID. The duration period of the project was five years, and with two additional years were operation funding was reduced (Schwartz & Kampen, 1992). The primary purpose of the project was to strength advisory service through training and visit model, which was popular in the 70s.

This approach assumes that advisory agents are poorly trained, they do not have contact with farmers, and the main reason is that they lack logistics and supervision support. In order to help farmers to increase their productions, advisory agents visit farmers regularly. Agents are continuously trained by professional extensionist, and it is a top-down approach, and mostly, it is involved with external donors for covering costs. Success is measured in terms of production increase in the area where the program covers (Feder, et al., 2006).

The project has been reasonably successful, the size and the experience of advisory agents have grown dramatically, and the number advisory activities (farmer’s field days, group meeting, and on-farm trials) have increased. Furthermore, four agricultural secondary schools (Afgooye, Jowhar, Camuud, and Dayaxa)) and regional training centers were established (Abukar, 2019).

Lower Shebelle, where Afgooye district located, was one of the three regions where research and training activities have been concentrated. The other two regions were the middle Shebelle and bay region. These three regions were focused since they were considered the most productive regions in the country,

and the advisory agents in these three regions were better supported and equipped (African Development Bank, 1988).

During the 70s and 80s, the focus of the Somali government was to produce highly qualified extension agents in order for them to meet national needs. As a result, highly qualified extension officers graduated from agricultural colleges and the Somali national university's faculty of agriculture. With the help of these agents, around 200,000 family farmers have acquired new farming skills. In addition to that, several extension agents were sent outside of the country to acquire higher education, and 400 students completed their master's degree and returned to the country (Abukar, 2019).

In addition to that, another project called National Agricultural Technology and Training Project (AGTECH) was planned to start, although civil war broke out in 1991 before the implementation of that project. This project was a university-based advisory model (the educational institution approach), which would focus on the interaction between advisory, research, and the Somali National University (Abukar, 2019).

The educational institution approach says that local universities have technical knowledge which is useful and applicable to the local farmer's context. The main objective is that the university's students, teachers, are involved in the program to help farmers learn about scientific knowledge, and in return, they learn from the farmer's experience. The educational institutions control the program, and its success is measured to the extent to which farmers attend the advisory activities provided by the university (Rivera & Alex, 2004).

2.4. Smartphone and ICT Usage as an information delivery tool

Generally, the use of ICT in agriculture has grown in both scope and scale in recent years (FAO, 2017). As the world population is expected to increase in the coming years, agricultural production should also increase to meet the future world food demand (FAO, 2017). This is where ICT could play a role by collecting and sharing timely information on weather, markets, inputs, research results, and provide this information to the farmers through ICTs tools.

Small scale farmers in developing countries, when their growing season start, they based their choices (what to grow, which inputs to use, when to grow, etc.), using the information that is available to them. In most cases, very little information is available to them, Information and Communication Technologies (ICT) could offer the possibility to make right decisions on their fields to achieve higher levels of food security by bridging this critical information gap (Wu, et al., 2018).

The penetration of mobile technology in rural areas in developing countries have made agricultural communication process readily accessible to the rural farmers (Saravanan & Bhattacharjee, 2014). Since traditional advisory agents do not effectively reach the growers in rural areas with a different location, using ICT tools in advisory service, particularly mobile phones, will enable broader advisory coverage and improves advisory efficiency in agriculture (World Bank, 11). Mobile technology in the advisory sector is primarily used to deliver information to growers about farming techniques, market prices, crop advisory, and weather information (Billings, et al., 2018).

Farmers with smartphones and have internet access are well suited for digital advisory services and other decision support tools (Bonke, et al., 2018). Some farmers in rural areas, particularly the youth generations, own smartphones and spend significant time on the internet. The majority of them have active social media accounts, and farmers prefer simple apps that are friendly and can be used at the farm level (Davis, et al., 2018). It is essential to identify the apps that farmers see beneficial and more likely to be used.

As reported by (Saravanan & Bhattacharjee, 2014), there are several crucial factors needed for the success of the smartphone for agricultural advisory service. Firstly, partnership with local universities for content generation is essential, since specific content generation is more beneficial for the farmers then generalized advisory content. When it comes to content generation, the public sector relies on agricultural institutions. However, private sector initiatives can generate location-specific information in partnership with others who can deliver relevant content.

Moreover, to ensure the sustainability of the service, continued innovation is needed. In addition to that, timing is a crucial factor, and farmers should get the information they need on time, quality of the information is essential, personalized specific information have more value for the growers compared general ones. Finally, providing farmers with relevant information will enhance the credibility of the advisory service (Babu & Joshi, 2019).

The main challenges that could face the implementation of the smartphone advisory service are lack of relevant digital content, illiteracy among rural farmers, and rural mobile infrastructure limitations, for instance, electricity or network problems (Wright, et al., 2016).

It is essential to assess the potential demand for a mobile advisory platform, and this can be known by asking farmers their willingness to pay the service (Bonke, et al., 2018). It is crucial to consider the financial impact that service could have on the livelihood of the farmers, and the farmer's payment of the service is correlated to their expectation that the service will reduce their total cost associated with farm management (CGIAR, 2019).

In addition to that, it is vital to explore the factors that could affect the grower's willingness to adopt the smartphone and topics that farmers perceived useful to them (Bonke, et al., 2018). Furthermore, there are number of factors that might affect smartphone adaptation from farmer’s perspective, factors like farm size, the values of the crops grown, familiarities of smartphone usage, educational level, age, could increase or decrease the likelihood of the smartphone’s adoption among the rural farmers (Wanglin, et al., 2018).

Young farmers with the ability to read and write are more likely to adopt smartphone technology, contrary to the old generation (Irungu, et al., 2015). It assumed that the farmer's age and smartphone adaptation have a positive correlation.

2.5. Conceptual Framework for Analysis

Many theories have been developed over the years, in order to explain the person's usage behavior towards the technology (Lai, 2017). These theories included, the theory of reasonable action (Fishbein et al., 1975), the theory of diffusion of innovations (Rogers, 1995), the theory of planned behavior (Ajzen, 1985), the theory of task technology fit (Goodhue et al., 1995), decomposed theory of planned behavior (Taylor et al.,1995), the first technology acceptance model (Davis et al., 1989), the second technology acceptance model (Venkatesh and Davis, 2000), unified theory of acceptance and use of technology (Venkatesh et al., 2003) and the third technology acceptance Model (Venkatesh and Bala (2008)).

Three theories among the mentioned theories were reviewed, compared, and finally, a conceptual framework is developed (figure 3). The theoretical aspects in which this conceptual framework is built are from the theory of task technology fit, the first modified version of the Technology Acceptance Model, and the Unified theory of acceptance and use of technology.

The framework was developed in a way that makes it more understandable and applicable to the study context. It was developed after the field-data was collected, and it used to analyze the findings of the study and to argue in the discussion chapter.

This study is not going to present the literature review of these theories; however, a brief description of the main used theories is presented below.

The technology acceptance model (TAM) initially proposed by Fred Davis in 1986, focuses on a person's attitude toward using new technology. The user's

acceptance and the use of the technology are based on the individual's perceived ease of use and usefulness of the technology (Lee, et al., 2003).

The task technology fit (TTF) theory developed by Goodhue and Thompson in 1995, and it argues that the proper fit between the technology capabilities and the demands of the task is likely to increase the utilization of the technology (Dishaw, et al., 2002).

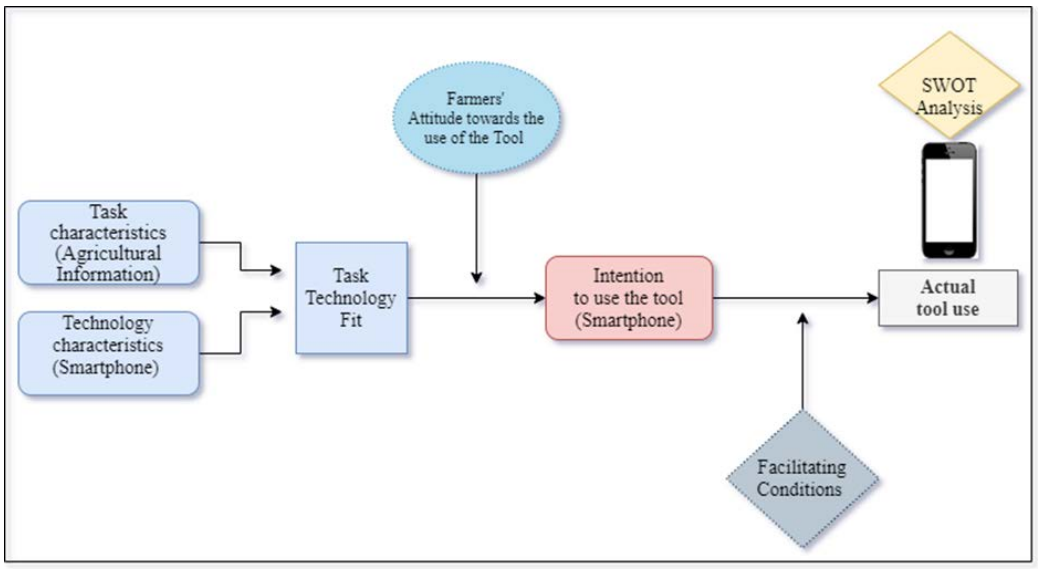


Figure 4 Conceptual framework

The first part (blue light) of the framework is from the theory of Task technology fit. When delivering agricultural information (Task), a system that is both cost and time-efficient is needed (Technology), smartphones are more efficient for the delivery of information, and it can be utilized for information delivery in the study area. In this case, both technology and task are fit together (literature review and Fieldwork). Since the technology (smartphone) and the task (information delivery) are fit together, the next phase is to know the grower's intention to use the smartphone (fieldwork).

According to the technology acceptance model, perceived usefulness and ease of use of the smartphone have a direct influence on the grower's intention to use the tool, and the attitude of the farmers is influenced by external variables like experience, age, etc.

The farmer’s intention to use the smartphone plus facilitation conditions like (information sources, internet infrastructure, farmer’s ability to buy the smartphone, etc.), will determine the actual smartphone use in the study area.

Finally, in order to assess the usage and adoption of smartphones for information delivery in the study area context in a comprehensive manner, a SWOT analysis was conducted. SWOT stands for strengths, weaknesses, opportunities, and threats and it is an analytical assessment tool that is used to identify the strength and weakness (internal factors) as well as threats and opportunities (external factors) that could have an impact on the feasibility of using the smartphone in the study area (Ghaffari, et al., 2014).

3. Methodology

3.1. Research design

Research design is the overall strategy that the researcher selects in order to combine the different components of the research in a logical manner (De Vaus, 2001). According to (Creswell, 2014), there are three main research approaches that most researchers use when carrying out their studies, namely, quantitative approach, qualitative approach, and mixed methods approach. Researchers choose their research approach based on their prior research experience, the requirement for their disciplines, and their worldviews.

The way researchers designed their studies and interpreted the results is related to their philosophical worldview. As stated in (Creswell, 2014) , worldview is "*a basic set of beliefs that guide action*." For that reason, the researcher must present the type of philosophical worldviews that is proposed in the study.

I based my research design approach to this study on a pragmatic world view. The Pragmatic worldview, researchers are free to choose the methods of the research that best meet their intended research objectives (Creswell, 2014).

A mixed-methods approach followed the design of my thesis study. Mixed methods research involves collecting both qualitative and quantitative data; by doing so, the researcher gets added value (Creswell, 2014). Using mixed methods increase the credibility of the study findings, complement each other, and it gives the researcher to cross-check the final findings (Hesse-Biber, 2010).

3.2. Data collection

In this study, both qualitative and quantitative technique of data collection was employed. Qualitative data was obtained in the form of interviews and observation of real-time settings, while Quantitative data were collected in the form of questionnaires.

The fieldwork data was collected from 23rd December 2018 to 10th March 2019. During that period, I stayed in the capital (Mogadishu).

Qualitative data used in this study were gathered in the form of interviews and observation. In total, ten interviews were carried out with the following target groups, the Somali National University (2 Interview), the federal ministry of agriculture in Mogadishu (1 Interview), Internet providers (3 Interview), and electronic stores that sell smartphones (4 Interview) in the capitals' main market (BAKAARA).

The informants from the Agricultural institutions (Ministry and University) were selected using purposive sampling technique, in order to have better understanding the context of country's agricultural advisory institution and to discuss the main factors that they think could influence the use and adoption of the smartphone as an information delivery tool in the study area context. The interview was unstructured, and there were no questions prepared beforehand, however, a topic list was prepared indicating the areas where discussion focus will be. These interviews lasted between 40 minutes to an hour.

I visited the Somali National University's main campus in Mogadishu. A lecturer from the Faculty of Agriculture and Environmental Science invited me to give a guest lecture to his undergraduate students. After I delivered the lecture, I had a chance to interview the lecturer, asked the current status of the university, especially the department of agriculture. During the seminar, I had the opportunity to mingle with the students. It is worth to mention that several students that participated in the seminar were themselves farmers, and they mentioned during the discussion session that they share the knowledge and information they receive from the university to their fellow farmers. Furthermore, approximately all the students that participated in the seminar have smartphones with internet access.

Furthermore, the lecturer introduces me to another university lecturer in the department, who was an extension agent before the civil war, and I had an interview with him.

Figure 5 Seminar at Somali National University's main campus in Mogadishu about farming systems.

In addition to that, I visited the Ministry of Agriculture and Irrigation (MOA) in Mogadishu, especially the department of agricultural advisory services. The main purpose of my visit was to know the past and present status of the country's agricultural extension services, and I had an interview with the head of the extension department. The meeting with the head of the extension department was beneficial, and she shared with me information regarding the current status of the extension department. However,

the old records of the status of agricultural extension in the country were lost during the civil war.

The head of the extension department gave the name of the last chairman of the department of Agricultural extension and production before the civil war. With the help of Facebook, I was fortunate to find him, and despite his health problems, he shared with me valuable data that helped to have a clear picture of the past status of agricultural extension in the research area.

Furthermore, the observation technique was used when visiting Somali's main market (BAKAARA), and field notes were made in each visit. Four different electronic stores that sell smartphones in BAKAARA market were visited in order to know the prices of the smartphones. In addition to that, the offices of the three leading internet providers in the capital were visited. One informant for each company was interviewed, and the interview lasted between 5 to 10 minutes. The questions that I asked the representatives of these companies were related to the cost of mobile data and their network coverage.

The quantitative data used in this study, a questionnaire with fixed questions were developed for the farmers. Where all the information that is needed to capture were listed beforehand, and in order to identify the challenges and opportunities, farmers face in accessing and using smartphones in the study area context and their information needs.

In total, 30 farmers from two main vegetable producing areas in AFGOOYE district took part in this study. Vegetable growers were sampled with the snowball sampling technique. According to (Tongco, 2007), snowball sampling is “asking an informant to suggest another informant, following purposive sampling."

Farmers were approached face to face because it is easier to explain unclear questions to the participants, and fixed questions were asked to the farmers. This method allows me to cover all the necessary information to answer my research questions; at the same time, respondents can introduce topics that they think are relevant.

I chose two villages in the Afgooye district, called SAGAALAD and JAMBALUL, as the location for my study. One reason I chose these villages was the fact that these areas are considered the most vegetable production areas in Afgooye, and the second reason was, two years ago, I did a study on vegetable production in Afgooye district, and I had an existing contact with the farmers in those areas.

The study area is located 30 km far from the capital. During that period, I traveled to the study area on three different occasions. Before each travel, I printed the questionnaire in

order to fill during the field visit. However, if the farmers introduce a topic that was covered in the questionnaire, field note was made.

After I finished the collection of the qualitative data, I contacted two farmers in JAMBALUL and SAGAALAD that I had their contact details. Firstly, the farmer in JAMBALUL invited me to his farm, where I stayed for two days (2nd and 3rd February 2019). During this period, the farmer introduced me to 10 vegetable farmers in the JAMBALUL area, and I had the chance to fill 11 questionnaires.

My second and third visit to the study area was 11, and 19 February 2019 and the rest of farmers that helped me to fill the questionnaire were from SAGAALAD area. When I was filling the questionnaire, I interviewed the growers both as a group and individually. In general, farmers were very friendly, and we sit under the shade of a tree, and the interview was conducted in their farm fields.

During the fieldwork trips, each time I complete the filling of the questionnaire, I had an open conversation with the surveyed farmers regarding the overall challenges and opportunities that they think exist in vegetable production in general and using smartphones as an information delivery tool in particular. These conversations helped me to gain an understanding of the overall context of the study area.

Figure 6 Author and the contact farmer in the study area observing lettuce farm in Afgooye.

3.3. Data analysis

The quantitative data from the surveyed farmer's questionnaire was analyzed using statistical tools (Excel and SPSS 23). Descriptive statistics were used to describe and summaries the basic features of the collected data. Data is presented in graphs in order to identify patterns in the data, and finally, the thesis's Conceptual Framework is used to explain those patterns.

Regarding the qualitative data collected through observation and informant interview is summarized and presented in a narrative form (Silverman, 2006).

3.4. The validity of the study results

In this study, I used the following two strategies in order to ensure the validity and credibility of the research.

Triangulation: I triangulated the methods of data collection. In this way, I can ensure the research validity because collecting the data through one technique; for instance, a questionnaire can be biased and questionable (Golafshani, 2003). This strategy has helped me to have a rich picture of my study topic, and I was able to cross-check the final findings. Moreover, the study was conducted in Somali, which is the researcher's first language of communication.

Self-critical reading: during the thesis writings, I tried to back up any claim that I stated in the thesis with evidence, I tried to be sensitive to my assumptions since they can affect my argument (Wallace & Wray, 2011).

4. Empirical findings

The result chapter consists of three sections. The Frist part results from the farmer´s questionnaire (30 farmers) are given, and it is structured according to the survey´s guiding questions. In the second and third sections, the outcome of the informant's interview and the findings of the author's observation are presented.

4.1. Information Users Context (Farmers in the study area)

4.1.1. Socioeconomic characteristics of the surveyed farmers

The vegetable growers interviewed in this research come from two villages in Afgooye district; SAGAALAD and JAMBALUL. The age span of the interviewed farmers ranged from 21 to 64 years old. More than half of the interviewed farmers were aged 25-50 years old, whereas only 13% of them were under 25 years old. All the interviewed farmers were male, and there were no female farmers who participated in the study. In the study area, farming is considered a male-dominated sector.

Vegetable crops currently grown in the study area are Tomato, Watermelon, Carrots, Sweet potatoes, Spinach, Pepper, Onion, Okra, Fresh chilies, Pumpkin, Bean, Collards, Groundnuts, and Lettuce. Furthermore, the main cash crops produced in the study area are Maize, Sesame, Bananas, and different citrus verities. Most of these crops are sold to the countries' main urban areas like Mogadishu.

Furthermore, 70% of the interviewed farmers' main income is from farming, where 23% of the farmers have another source of income, which is independent of farming. The average vegetable farm size is 1.7 ha. The average number of years that the interviewed farmers engaged for vegetable production is 12 years. Although the experience of the grower is important, there were no significant differences between the farmers regarding their vegetable production methods.

The literacy level of the interviewed farmers is categorized into four groups. The first group is illiterate, meaning those farmers who cannot write or read. The second group, primary education, refers to schooling up to 4 years or those farmers that can read and write the Somali language. Secondary education refers to 10 years of schooling or more, while college or university education refers to any education above the secondary school level.

26% of the interviewed farmers were illiterate, while 40% of them have primary education, and finally, a small number of the participants of the study have a university or college education. The below figure (7) shows the cross-tabulation of the educational levels of the interviewed farmers and their age.

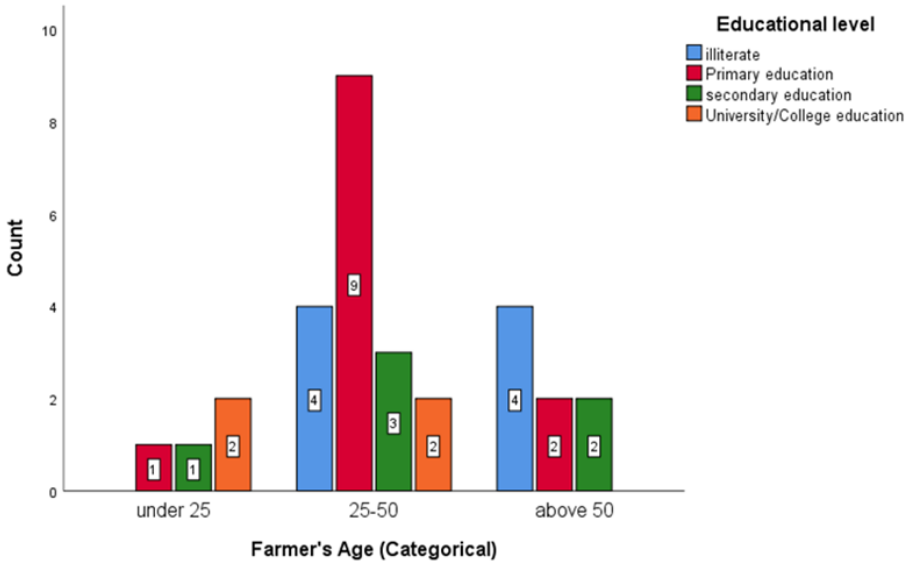


Figure 7 Cross-tabulation of farmer´s age and their educational level

In addition to that, around 55% of interviewed farmers own their farmland, where 40% of them rented or shared the land. In the study area, there are two systems regarding the rented or shared land. For instance, when the farmer is renting farm-land, he agrees with the landowner that he will give him/her the rent, and the farmer owns whatever he produces. The other system is that the owner of the land provides the seeds, prepare the land, and pays the oil of the machine and the farmer will do the rest of the work. At the end of the season, the final yield will be shared equally.

The interviewed farmers that rented or shared their farmland mentioned that they had chosen vegetable production because of its short growing period, and they are also the most common crops grown in the rented land. Growing crops that need more time to mature in rented land is considered a risky investment in the area. Several farmers mentioned that sometimes the land-owners change their minds and ask the tenant to leave. As a result, investing in crops like fruits is risky as the investment may be lost.

The primary source of water for all the interviewed farmers is from river Shebelle. The most common irrigation system used in the study is furrow irrigation. Furrow irrigation system is also referred to as surface or flood. It is an uncontrolled irrigation method where farmers flood the water into their field and wait until the land absorbs the water.

However, this system is insufficient; 80 percent of the water is lost through evaporation and leakage before it reaches to the crop (Sandra, 2001).

Furthermore, the interviewed farmers sell their harvested products to local traders or directly to customers. The main actors in the market chain are producers, local traders (brokers) who assemble vegetables from the fields, transporters, retailers, wholesalers, and consumers.

During my field trips to the study area, I observed that the condition of the main road between the study area and the capital was in poor condition, the interviewed farmers mentioned that they have difficulties in transporting their products to the BAKAARA market, especially in rainy seasons when the transportation cost becomes very high. However, in July this year (2019), the construction of the major road between the Afgooye district and the capital started. The Qatari government funds the construction project, and the road is two-way dual-lane that connects the City of Afgooye to Mogadishu city. This newly built road is going to solve the transportation problem in the study area, as farmers will be able to deliver their fresh produce vegetables to Mogadishu city in less than 30 minutes.

4.1.2. Farmers' Access to ICTs

More than 90% of the interviewed farmers have access to Radio, where approximately half of them own or have access to TV. The interviewed farmers own a mobile where around two-thirds of the growers own or have access to a smartphone, as figure (8) shows.

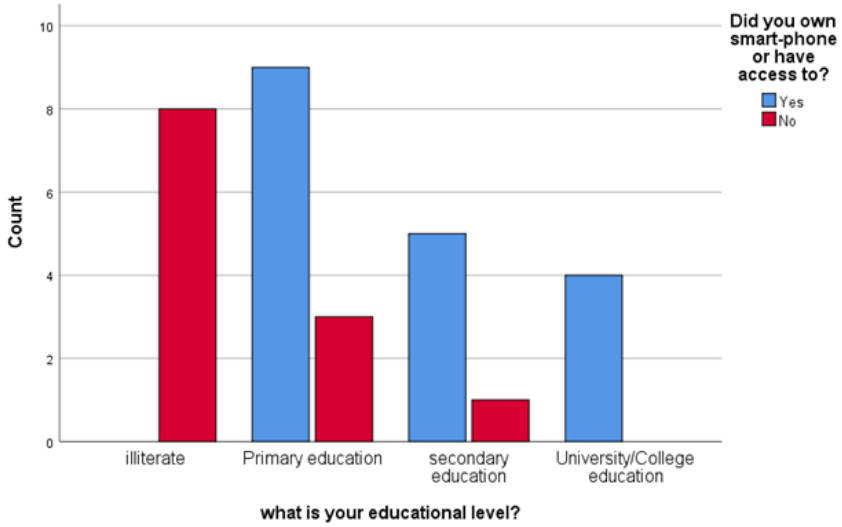


Figure 8 Cross-tabulation of the surveyed farmers' educational level and smartphone ownership

Farmers were asked if they face any difficulties with usage of the smartphone, large portion (40%) of the farmers reported that they do not have any difficulties when using the smartphone, equally important, 40% of the interviewed farmers who do not own a smartphone replied that they might have troubles with smartphone usage if they have one (maybe). Moreover, 20% of the farmers who have access to the smartphone but not own, indicated that they face challenges when using the smartphone.

Moreover, farmers that do not own a smartphone, which was around 55%, were asked if they could afford to buy a smartphone. The majority (11 farmers) commented that they afford to buy a smartphone, whereas few farmers (6) replied that they have not enough money to buy a smartphone.

However, during my stay in the capital, I observed that smartphone ownership is growing among the population in general and the young generation in particular.

Furthermore, farmers were also asked if they have access to the internet; 50 % of them indicated that they have access to the internet. The below table (1) shows the critical barriers to mobile internet adoption in the study area, according to interviewed farmers.

what are the key barriers to mobile internet adoption in your area?

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	network coverage	6	20,0	20,0	20,0
	high mobile internet tariffs	6	20,0	20,0	40,0
	lack of digital literacy	7	23,3	23,3	63,3
	Lack of awarness	1	3,3	3,3	66,7
	Others	10	33,3	33,3	100,0
	Total	30	100,0	100,0	

Table 1 Barriers to mobile internet adaptation in the study area

In order to have a clear understanding of the barriers to smartphone adoption in the area, respondents were asked to select one answer from the five possible options, as table 1 shows. For this question, the option "other" was included to allow the respondents to enter their answers if none of the given options apply to them, and this will help to get comprehensive data. 33% of the respondents selected the option "other." Moreover, farmers that selected the option "other" mentioned that they left their smartphones at home because of security reasons. I observed that the vast majority of the surveyed farmers use regular mobiles when they are in their fields. This is a fact that farmers located outside of the government-controlled area are afraid to use smartphones. Instead, they use it when they are back in their homes.

In addition to that, the answer option "lack of digital literacy" was included in this survey question, in order to explore if the surveyed farmers have the digital skills to access and search agricultural information from online sources. Around 23% of the respondents selected the option "lack of digital literacy."

Furthermore, respondents were asked if they use any social networking apps on their smartphone, 40% of the interviewed farmers indicated that they use social media apps. Then, farmers were asked to name two social media platforms they use often. As figure (9) shows, Facebook, WhatsApp, and Imo are the most common apps that the interviewed farmers use, likewise, very few participants (8%) indicated that they use other apps like YouTube.

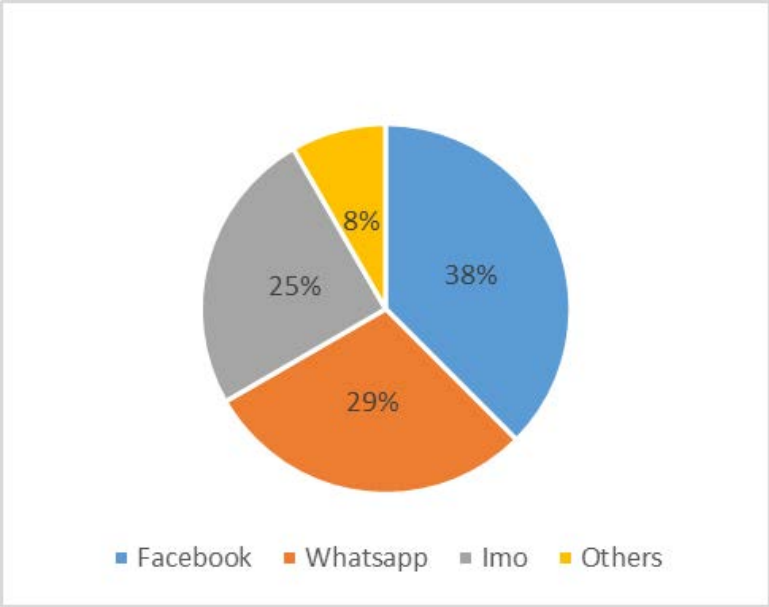


Figure 9 Respondents' most frequently used social media platforms

4.1.3. Farmers' Information need and prioritizations

All the interviewed farmers indicated that, currently, they did not receive any agricultural information from any information source provider, whether private or public.

So in order to know the information needs of the farmers, they were asked to prioritize their information demand by selecting three topics that they need on information and rank them according to their importance, where one is the most important and three less critical. Figure (10), shows major topics of information needs identified by the farmers. The topics were listed according to their priorities. This was made in order to know which topics are more important to the farmers than others.

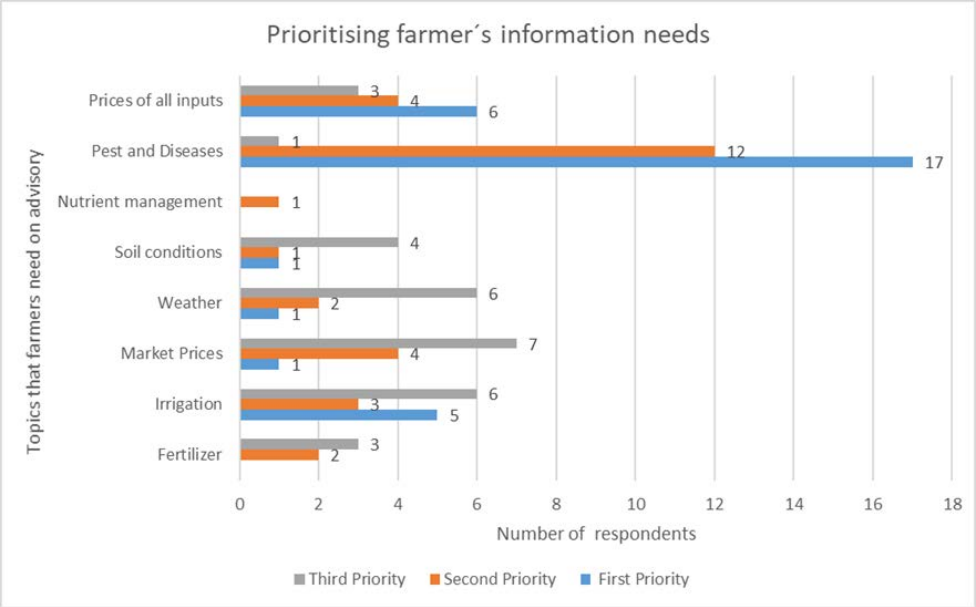


Figure 10 Prioritizing farmer's information needs

According to the interviewed farmers, pests and diseases are the number one topic that all the farmers indicated that they need on advisory.

In order to understand the farmers' information sharing behavior in the study area, they were asked if they share any received information with their fellow farmers. 33% of the interviewed farmers indicated that they not shared any information received, while 60% of the growers reported that they share with close friends and relatives. A small number of the farmers (6%) share any received information to every-one regardless.

4.1.4. Farmers' ICTs preference

Farmers were asked their preferred methods for delivering agricultural advisory services through ICTs. As Figure (11) illustrates, half of the interviewed farmers prefer to receive the information through the radio, where 30% of them favor to receive advisory information through social networking apps.

Radio used to be the most important mass media in Somalia; however, currently, the Somalia media landscape consists of both TV and radio. The radio and TV stations have grown in number, although the radio is still the primary source of information and news in Somalia. Now there are approximately several TV stations based in Mogadishu, which have their websites, affiliated radios, and Facebook pages. Furthermore, the leading radio

stations in Mogadishu, according to their area coverage, are Mogadishu radio (State-run), Goobjoob, Kulmiye, Shabelle, and Dalsan.

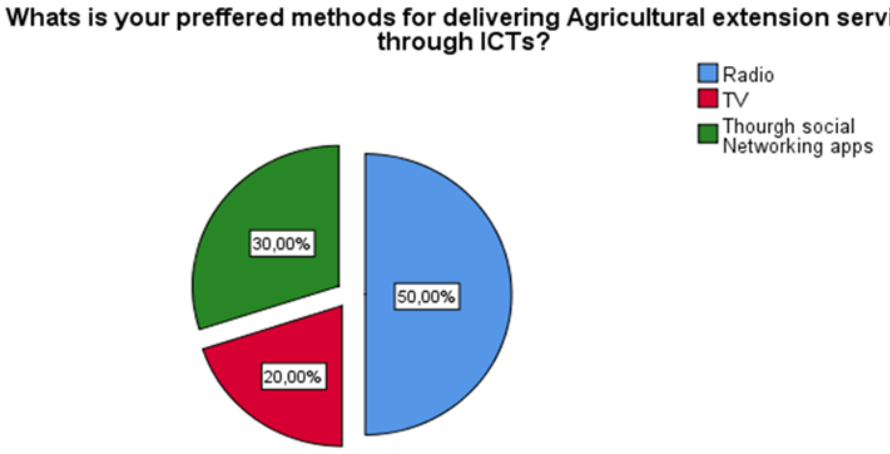


Figure 11 Farmers' ICTs preference

On the other hand, the Somali TV stations are located both inside and outside of the country. The Somali language is the language used when broadcasting. The media outlets are employed for different purposes, for instance, community information, Islamic teaching, etc. Although these TV stations have their domain, they use Facebook to present their news. The figure (12) shows the number of Facebook followers per Somali TV Facebook page (19 June 2019). As the figure shows, Universal, Saab TV, and SNTV (State-run) Facebook pages have the most fans on Facebook. The most liked Facebook page is Universal TV.

In general, the use of social media in Somalia has increased in recent years, and most Somalis access their social media platforms through mobile phones. I observe that some of the interviewed farmers and the population, in general, are connected to social media. The social media could contribute to the farmers' mobilizations towards using digital agricultural advisory services.

Although radio is the most important media channel in the study area; however, in remote rural areas, both access to the radio and TV is limited.

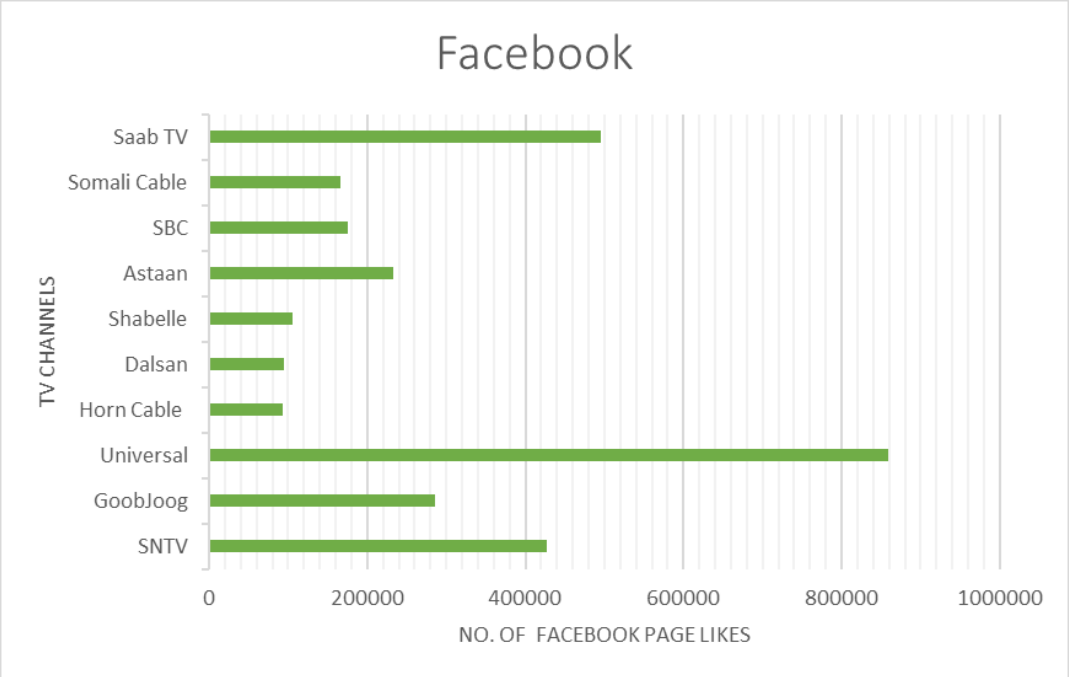


Figure 12 Facebook TV Pages statistics in Somalia

In addition to that, surveyed farmers were asked if they are enthusiastic about the digital advisory service; 40 % of the interviewed farmers replied yes, while around 25% of them were not sure, and the rest of the farmers were not enthusiastic about the service.

Furthermore, surveyed farmers were asked their willingness to pay the digital advisory service in exchange of information, around 40% of them reported yes, while approximately one-third of them were not sure and the rest of the interviewed farmers were not willing to pay the service.

Finally, in order to know the best effective way to deliver the advisory information to the growers, they were asked to give two of their preferred type of information delivery methods according to their opinions. As the below chart (13) shows, a considerable number of the surveyed farmers selected, the training method as their preferred method of advisory delivery, on the other hand, ICTs based extension method become their second preferred method of information delivery.

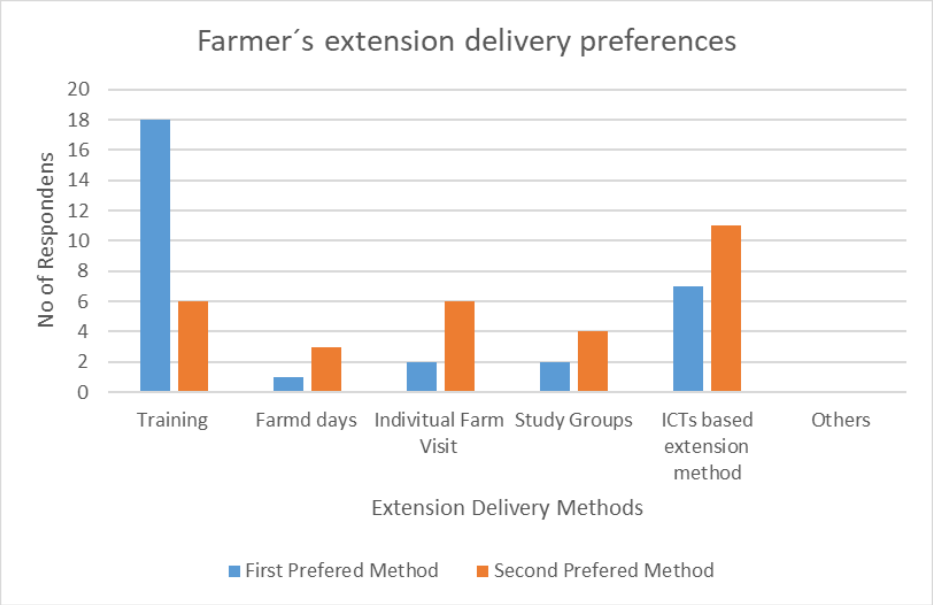


Figure 13 Farmers' agricultural advisory delivery methods preferences

4.2. Information providers (The institutional context)

Three informants from the country's agricultural institution we interviewed, the results of their interviews were summarized and presented below. In addition to that, the interview was unstructured. So, there were no questions prepared beforehand; instead, a topic list was prepared to indicate the areas where the focus will be on.

Currently, the extension department is under the plant production unit, and their work is limited to national extension policy development, agricultural data collections, and student and farmers training for some occasions.

The department is not able to give production advice to the farmers because of several reasons, mainly security and lack of finance. The main challenge is related to security because extension agents cannot visit the main vegetable production areas. On the other hand, the department is functioning well, and it has its own staff, and finding another feasible method to communicate with the farmers will help them to fulfill their roles and responsibilities. I observed that the staff of the ministry, the majority of them were youth, and approximately all of them have a smartphone with internet access, as some of the staff told me during my visit.

Furthermore, the Somali national university was reopened in autumn 2014, and the first butch of agricultural students graduated in spring 2019. It is believed that these graduates

could be a potential for the reconstruction of the agricultural sector in general and advisory services in particular.

Due to a lack of funding and resource limitation, the Somali national university still did not reopen its main agricultural research station, where they use to do field trials and experiments.

The Somalia government has been working with the international communities to reform its state institutions, particularly the economic and national security institutions. Investing and rebuilding these institutions is seen as part of attaining the Sustainable Development Goals (SDGs) by international communities (KOCIJANC & PUGLISI, 2019). Currently, the International Monetary Fund is supporting the Somali government for its effort to persuade its creditors to erase the country's $5 billion debt. The country's debt relief is expected in February 2020 according to the country's finance minister (Shalal, 2019), and finally, in 30 years, the country will have access to international development assistance.

4.3. The State of smartphone prices and mobile data in Mogadishu

In order to know the smartphone prices and the cost of the internet credits, the main BAKAARA market located in the capital was visited at three different times. Although the market is not located in the study area, it is only 30 km away from it, and the farmers in the study area buy phones and farm inputs from the market.

The lowest smart-phone price in BAKAARA Market is between $40 to $75. The figure below shows an electronic shop in BAKAARA Market and a low budget smartphone called INVENS (Produced in India), which costs $50.

Figure 14 Electronic shop in BAKAARA Market (Mogadishu)

During the study, three internet providers were identified in the study area, namely Somtell, Hormuud, and Somnet. The companies were reluctant to share information related to their internet subscribers, for instance, the number of subscribers that each operator has. In addition to that, the identified companies offer both 3G and 4G mobile networks. The cost of mobile internet data and their network coverage is a different per company. The figure (15) shows the cost of 1 GB of mobile data between the companies.

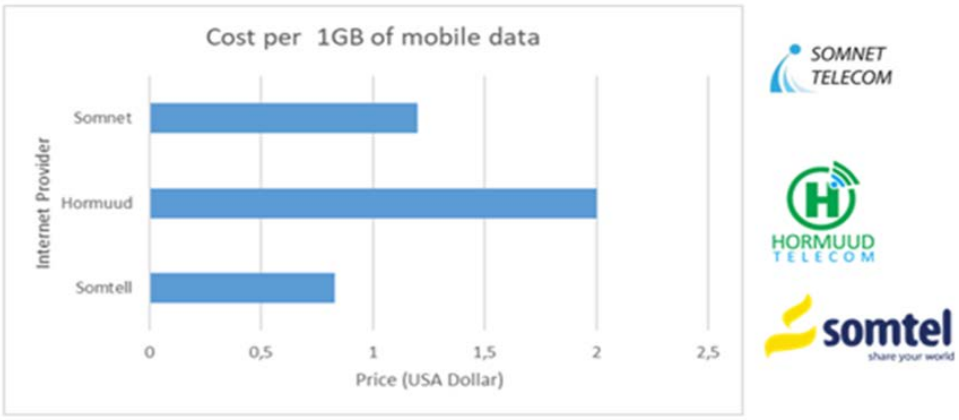


Figure 15 the cost of 1 GB of mobile data between the internet providers in the study area

Regarding the internet area coverage, the internet network of Somtell and Somnet is limited around the AFGOOYE area, where Hormuud network coverage is almost throughout the south and the center of the country.

5. Discussion and analysis

The main objective of this study was to assess the feasibility of using a smartphone as a tool to deliver agricultural Advisory services in the Afgooye district. In this chapter, I intended to discuss the key findings of the research using the thesis's conceptual framework, and themes emerged from the collected data analyses. Finally, The SWOT analysis tool was used to determine the strength, weaknesses, opportunities, and threats of using smartphones as an information delivery tool in the study area context.

5.1. Farmer's attitude towards the use of smartphones

Results of the questionnaire and direct observing show that the interviewed growers' attitude towards the use of the smartphone is influenced factors like age, literacy level, and source of income. The study found out that there is a correlation between the respondent's educational level and their age, as the age of the respondent increase the chance that they are illiterate also increases. For instance, the surveyed farmers who were not able to read and write, all of them were above the age of 25 years. Furthermore, education was one of the most determinants of whether surveyed farmers are willing to use the smartphone or not. The present findings seem to be consistent with other studies that found young farmers that can read and write are more likely to use smartphones compared to farmers above 50 years old (Irungu, et al., 2015).

Another important factor is the farmer's source of income. In the study area, respondents that own their farmland or have another source of income, which is independent of farming, are more likely to own a smartphone or buy one compared to those who are rented or shared their farmland. Furthermore, one common challenge that the interviewed farmers encounter is the fact that the vegetable market prices are not fixed. For instance, when there is overproduction, the market prices go down. As a result, farmers get low prices for their products. This shows that the farmer's income diversification is an essential factor that could facilitate the use of the smartphone in the study area. Furthermore, the diversification of the farmer's income will also provide a safety net against market fluctuations, as the other studies show (Senger, et al., 2017).

5.2. Farmers' Access to ICTs and their preferences

One unanticipated finding was that all the interviewed farmers own mobile phones or as they called it (Niicle). The surveyed Farmers who own this type of mobile also have access to radio. The farmers use their mobile for different purposes, for instance, communicating with each other or ordering farm inputs from the main market. Also, the

surveyed Farmers use mobile money service, which is considered more saver compared to in-person cash payments. On the other hand, the rise of mobile payment over the last years has made the Somali population, in general, more comfortable with digital services (Tsan, et al., 2019).

However, when it comes to smartphone ownership, one-third of the interviewed farmers own or have access to, as mentioned in the result chapter. The surveyed farmers who own a smartphone stated that they do not have any difficulties in using it because they have been using the smartphone quite a while. On the other hand, those surveyed farmers who have access to smartphones and the internet mentioned that one of their households have a smartphone with internet access, mostly, they use the smartphone when they need to communicate relatives that living abroad.

At the time of the study, $ 45 was the average cost of a smartphone with a 4 G mobile network. If you compare the smartphone prices in Somalia and Sweden, for instance, a low budget smartphone in Sweden will cost you $100. This could be seen as a considerable development in a country like Somalia, where local purchasing power is low. On the other hand, it could constitute a limitation, since many interviewed farmers indicated that they could not afford to pay a smartphone.

Moreover, a number of TVs and Radio were identified in the study area. It was apparent that the radio is still the primary source of information and news in the study area. The majority of the interviewed farmers commented that they have access to the radio; this makes the radio the most accessible and preferred ICT tool in the study area. As mentioned, the interviewed farmers and a large portion of the population in the study area that own mobile phone (preferred mobile type is called Tecno) also have access to radio. Surveyed farmers prefer this mobile; because it is an affordable mobile phone equipped with FM radio, and it has good battery life. As a result, farmers can use long hours without charging their batteries (Qumer & Singh, 2019).

Using radio as a tool to deliver information to farmers can be seen as a more cost-effective and applicable to the study area compared to other advisory delivery methods mentioned in this study. However, from a practical point of view, farmers do need specific advice to their problems, and radio is seen in a one-way communication tool. On the other hand, general information like weather information, research findings, for instance, can be delivered via radio, and it can be used as a complementary tool when it comes to information delivery to the farmers (Rao, 2018).

According to the interviewed farmer's opinion, when asked their preferred type of delivery method, the ICTs based extension method ranked as their second preferred method of information delivery. This shows that surveyed farmers are aware that traditional advisory methods are not feasible at the moment because of many reasons mentioned in the problem statement. During the field study, it was apparent the value of information to them. On the other hand, one-third of the interviewed farmers were not willing to pay any information they could receive in the future. This result may be explained by the fact that buying and selling information is not common in the study area; some farmers believe receiving information should be free.

5.3. Information needs of rural farmers

Another raised point during the field study is the fact that surveyed farmers in the area did not receive any agricultural information from any information source provider. This is not meant that surveyed farmers in the study area are not interested in seeking agricultural information; on the contrary, they use some informal mechanisms like asking other farmers or farm input dealers if they need information related to seeds, pest, and disease management for instance.

Another problem that farmers in the study area face is the fact that the country's market is open and uncontrolled; there were no authorities when it comes price setting for essential inputs like seeds and fertilizers. In addition to that, there is no vegetable storage facility in the study area. So, when the farmers harvest their product, if they cannot sell quickly, the quality of the vegetable deteriorate since the temperature in the area is high (Valenzuela, et al., 2017).

Knowing the market information beforehand will help the farmers to harvest their products at the right time. As one respondent who shared the farmland with his brother explained, ''*when you bring your harvested yield to the market if there is overproduction for instance when you sell your product, the money you get it cannot cover the transportation cost, let alone profit or buying a smartphone''*. This shows access to knowledge and information will help the farmers to choose the right crops to grow at the start of the season according to the market demand (Altieri, 2002).

In order to bring greater benefits to the farmers, it is essential to understand the topics that they need on advisory. Pests and diseases were the number one topic that surveyed farmers in the study area indicated that they need on advisory. Pests and diseases post serious risk for vegetable growers in the study area, and farmers use chemicals to control

it. Another problem that farmers face is the fact that the country's market system is open and uncontrolled. When it comes to pesticides, herbicides, and fungicides, traders bring every type of these chemicals, even if these chemicals are poisonous or they are not suitable for the intended crops. Although the ministry of agriculture has departments that are responsible for controlling these types of products, I was not able to find if this department is functional or not at the time of this study.

During the field study, some of the surveyed farmers frequently asked me advice on pest and disease management. During the fieldwork, I introduced a surveyed farmer to a Plant pathologist. The farmer asked the Pathologist if he could visit his farm and help plant disease management. However, the pathologist was reluctant to visit the area because of security reasons. In this case, the farmer has access to the internet and communicated the pathologist using a social media platform (WhatsApp). The farmer has sent some pictures and short video clips via WhatsApp explaining the problem to the pathologist, and in return, the Pathologist gave some recommendations about ways that the farmer could control the disease.

In this particular incident, it was apparent that farmer’s dependency on chemical control was due to a lack of knowledge about other ways to control pests and diseases like biological and cultural controls. This clearly illustrates that growers in the study area need easily accessible knowledge on agrochemical applications, at the right dosage, time, and method, as this will reduce their dependency on chemicals (Naruka, et al., 2017).

Results like this will help the agricultural institutions and other relevant actors to have a better understanding of the farming situation in the study area at the field level. This is where smartphones could play an important role since the state agricultural institutions of the country are working now despite their challenges; they can still provide advisory services related crop management by communicating the farmers with the help of smartphones. On the other hand, farmers can take pictures, record videos explaining the problems they are facing; in return, advisors can give recommendations based on the data they received from the growers.

In addition to that, the Somali alphabet is the same as the Latin alphabet, which could be considered an advantage and convenient in Internet use, mainly when farmers and extension agents communicate with each other via smartphone.

5.4. Mobile internet tariffs (access and availability)

Another finding was the fact that the cost of mobile data among identified internet providers was very different. Somtell was the cheapest internet provider in the area, where an average of 1 GB of mobile data costs $0,83, followed by Somnet ($1,2) and Hormuud ($2). Although the reasons behind the differences were not found, it could be explained that Somtell, for instance, is based in Somaliland (self-declared state located in northern Somalia), they expand their internet services in Mogadishu in late 2018 (TeleGeography, 2018), and their cheap mobile data could be explained a marketing stagey to gain market share.

On the other hand, Hormuud is the leading telecommunication and mobile money provider in southern Somalia, one reason that could explain why their mobile data is more expensive compared with other firms in the area is the fact that Hormuud focuses more on business and home internet and they started to provide mobile data internet in this year (March 2019). In addition to that, one factor that affects the cost of mobile data is the data plan (daily, weekly, or monthly). In other words, mobile data validity matters, the mobile data that is valid for one day is cheaper compared to the mobile data that expires in 15 days, for instance. Besides, when you travel deep into rural areas, internet connectivity is the main challenge. However, if you are using Hormuud SIM-card, you can still have the network and access to your mobile internet data, the only pitfall is the fact that their internet mobile data is costly to the farmers.

Furthermore, the mobile data in Puntland region in Somalia is more-cheaper compared to the study area, an average 1 GB of mobile data costs $0.60, the more mobile data you buy, the lower price you pay, for instance, 12GB of mobile data costs $5 in Puntland (Jamac, 2019). The main reason why the internet mobile data is so cheaper in Puntland compared to the study area is the fact that Fiber Optic Internet reached this region in 2018, and the region is considered more stable compared to the study area (Pherali & Lewis, 2019).

At the same time, the cost of 1GB of mobile data at the global level is $8.53, which is more expensive compared to the study area (BBC, 2019). In addition to that, the cheapest mobile data in Africa is in Rwanda, and Sudan, with an average price of 1GB of mobile data, is $0.56 and $0.68, respectively (Howdle, 2019). Furthermore, Somalia ($1.3) has

the cheapest mobile data per gigabyte compared to neighboring countries like Kenya ($2.73), Ethiopia (($2.91), and Djibouti ($37). What is surprising is that Djibouti, which is a neighbor to Somalia, is one of the most expensive countries in which to buy mobile date (Howdle, 2019). This shows that the prices of mobile internet data in the study area could be considered very cheap compared to neighboring countries and the global level at large.

5.5. The use of social media as a source of agricultural information

As research results show, the use of social media among surveyed farmers and the Somali population, in general, has increased. Several identified TV stations use Facebook, for instance, to present their news and programs. It was easier to identify the number of Facebook flowers per TV; however, it was not apparent why some TV stations have more Facebook followers than others. I visited the Facebook pages of these TV Channels, the content of their programs, and the news was almost similar. Although the demographic data like age, gender, and location of their followers is not known, the TV channels can be used to share information on agricultural topics to raise awareness among the farmers to use digital agricultural advisory services (Bhattacharjee & Raj, 2016).

Additionally, from a farmer's perspective, since these TV stations are known among them, the possibility that farmers could use the information provided to them is high, since they could perceive the source-provider a credible (Shemfe & Oladele, 2018). Another important factor is trust since information shared through Facebook is lacking face to face interactions, knowing the information source provider will reduce the uncertainties, and the information shared by the authentic Facebook page is more likely to be used by the farming community (Liou, et al., 2016).

Facebook, WhatsApp, and Imo were the main social media apps identified in the area. Older surveyed farmers use WhatsApp and Imo often, although, Facebook usage is common among age groups, the biggest Facebook users observed during the study were young people. Old surveyed farmers in the study area consider Facebook more on youth App. Although these Apps can be used to share information, Facebook is a more public platform, and it has higher viral content than the other two Apps, which are relatively closed medium (Thakur & Chander, 2018).

5.6. The potential use of smartphones in the study area

The study identified several surveyed farmers that already have a smartphone and others who can afford to buy one. These farmers are well suited for the smartphone-based advisory service. It seems possible that these farmers would be in a position to not only engage this type of activity (Information delivery through Smart-phone), but they could also be job creators for recently graduated students from the local agricultural universities. As some surveyed farmers indicated that they are willing to pay the service in exchange for information, this demonstrates that even private sectors could play a role if they can provide timely information to the farmers in exchange for money.

Research from CTA (Technical Centre for Agriculture and Rural Cooperation) indicates that the presence of mobile money payments service will increase the chances that private sector investment in digital advisory services, as the farmers can pay the money digitally and in return, the services can be provided digitally. This is not meant that everything should be done digitally, as this could have a negative consequence, such as digital exclusion. For that reason, it is important to accompany the digital service with human interaction methods like training or farm days (Tsan, et al., 2019). In addition to that, a service that works well for illiterate farmers is also necessary.

Somalia is a country where almost every basic service, like education, health, is provided by stakeholders from the private sector. There are thriving business communities that have been built on trust during the civil war, where every other institution broke down. Understanding that context, this service can be seen as positive in a country like Somalia. At the same time, the private sector is mainly driven by profit, and it may leave vulnerable and rural farmers behind (Tsan, et al., 2019). This shows that active government involvement is necessary.

Surveyed farmers in the study area prefer location-specific answers to their problems, and for that purpose, location-specific advisory information should be created. When it comes to content generation, working with local universities is necessary since the universities have technical knowledge which is useful and applicable to the local farmer's context (Kansiime, et al., 2019).

In addition to the state university, there are a number of privately-owned agricultural universities located in the capital, and some of them have their own agricultural research stations, like Zamzam University. Every year a considerable number of agricultural students graduate from these privately-owned universities. During my stay in the capital, I visited the Zamzam University's campus located in Garasbeley, a few km west of

Mogadishu. With help from a Turkish foundation, the university set up a greenhouse (500 m2) for vegetable experiment purposes in 2015.

The dean of the university's agriculture department told me that the university had run several on-farm research trials. In these research trials, a number of crops like eggplant and cucumber, which is not familiar in Somalia, were planted and harvested successfully. In addition to that, the students from the university got the opportunity to do field trials and learn agriculture by doing. I observed that vegetable crops in the greenhouse were better quality than those planted in the open field.

At this stage, it is not clear the financial impact that this service could have the livelihood of the rural farmers in Afgooye, and it is natural to assume that farmer's willingness to pay this service is correlated to their expectation that the service will have a positive impact to their livelihood (CGIAR, 2019). For near future, to persuade the farmers to pay the service in exchange of information will be a challenge, until farmers understand that receiving credible information will help them overall management of their farming activities, and for long term, farmers will understand the power of information, if they see their peers are benefited the service.

Although the impact of this service will only be achieved when the service is utilized (Kabbiri, et al., 2018) . The implementation of this service, trust is essential. For instance, if the farmer's trust the source provider´s knowledge and they are more likely to use the information provided. In a post-conflict context, trust is vital so that farmers feel that their personal data will be kept safe (Kabbiri, et al., 2018).

It is worth to mention that I come across a number of theories and concepts in the literature which I can be used as a guide in my research study. However, I find out challenging to identify the most appropriate concept or theory in my study before I collect the field data. For that reason, I implemented the Inductive research approach during the study. According to (Corbin & Strauss, 2008), inductive research approach, the researcher starts with the collection of empirical data from the study area and then create a theory from the collected data. After I collected data that is relevant to my thesis topic, the focus was given the patterns of the data; as a result, the thesis's conceptual framework was developed.

Restricting this study to the use of smartphone and vegetable growers could be seen as a limitation; however, the study was focused on smartphones since it is seen as a best-suited tool when it comes to delivering location-specific answers to the farmers. Currently, agricultural advisory service through agents is not feasible in the study area

and is also not cost-effective. Specific information delivery is more beneficial for farmers than general information (Bonke, et al., 2018).

5.7. SWOT Analysis

As mentioned in chapter two, a system thinking approach was used to contextualize the topic of this study. The context map was developed to give an overview of the agricultural information system in the study area. The information providers and users were considered as internal components in the system. With that in mind, SWOT analysis is seen as a useful way to identify the strength, weaknesses, threats, and opportunities that could influence the feasibility of using the smartphone in the study area. The strength and weaknesses are considered internal factors that are specific to information providers and users, while opportunities and threats are considered external factors.

The result of the analyses is summarized in table 2 on the next page. It worth to mention that this SWOT analysis is based on only the data I gathered from the interviewed vegetable growers, informant interview, and my personal observations during the fieldwork period. The result of the analyses is further elaborated in the next chapter.

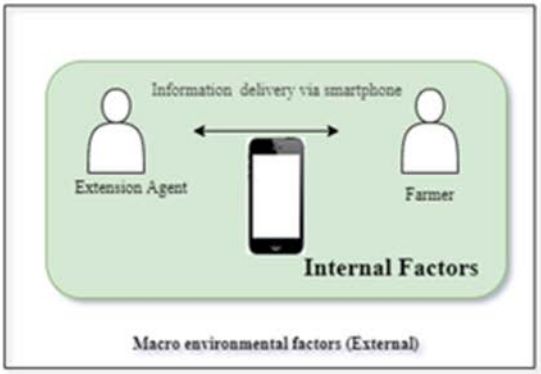
Table 2 A smartphone-based advisory system in post-conflict rural Afgooye: SWOT ANALYSE

Strength

- Some of the surveyed farmers own and have access to the smartphone.
- The country's agricultural institution is working.
- Some of the surveyed farmers and extension agents use social media apps, and there is a potential opportunity for them to share adversary information easily
- The smartphone will enable two-way information flow between the extension agents and farmers.

Weakness

- Not inclusive, since many farmers did not own or able to afford one.
- Illiteracy among rural farmers
- It Lacks localized agricultural information content and awareness among the stakeholders.
- Currently, there is no information linkage between information providers and users, so coordination is needed.
- The country's agricultural institutions are still in the post-conflict reconstruction stage; the main challenge is lack of funding and resource limitations.



Threats

- Security issues
- Mobile infrastructure limitations, especially network problems.
- Low smartphone ownership in rural areas (Accessibility).
- The high cost of internet data (Affordability).

Opportunities

- Cheap mobile data compared to neighboring countries.
- New Agricultural graduates from local universities.
- As a result of the overall ICT growth in the country, smartphone usage is increasing among the population.
- Many Somalis use mobile money payment service; the use of smartphone-based advisory service is potential.
- For the content generation, both public and private agricultural universities are there.
- The use of social media among the Somali population, in general, has increased.

6. Conclusion

In developing countries, small scale farmers produce most of the country's food, and access to agricultural advisory information will help them to increase their production capacities, careful management of their natural resources, and choose the right crops to grow at the start of the growing season according to market demand.

In the post-conflict context, farmers have limited access to advisory service as a result of a combination of many social, economic, political, and environmental factors that all interact with one another in complex ways, and these factors make the task of information delivery to the farmers through extension agents extremely difficult. However, with the help of ICT technology, farmers in rural areas could have access to agricultural advisory services, and now the service can be delivered in ways that were not realistic before.

The overall aim of the study was to assess the feasibility of using smartphones as a tool for delivering information to the vegetable growers in post-conflict rural Afgooye and a system thinking approach was used in order to understand better what facilitates or hinders the success of smartphone usage in the study area context. Smartphones have been identified as a best-suited tool when it comes to delivering location-specific information to the farmers.

Based on the findings of the study, the surveyed farmer's attitude towards the use of ICTs based extension methods, specifically, smartphones as information delivery tools, seems positive. The surveyed farmer´s attitude towards the use of the smartphone is influenced by factors like age, literacy level, and farmer's source of income. Likewise, surveyed farmers who have another source of income are more likely to own a smartphone or buy one compared to those farmers who rented or shared the land.

Moreover, all the farmers that participated in this study own regular mobile phones that are not smartphones. Farmers who own this type of phones tend to have access to radio. However, one-third of the interviewed farmers own or have access to smartphones. Furthermore, the average cost of a smartphone with a 4 G mobile network was $ 45 at the time of the study. Similarly, the average cost of 1 GB of mobile data was around $1. Besides, a number of TV and radio stations were identified in the study area. Although radio is the most important media channel in the study area, however, in remote areas, both access to radio and TV is limited. When asked about their preferred type of delivery method, farmers ranked training as the first preferred method, while the ICTs based extension method ranked as the second preferred method of information delivery.

Pests and diseases were the number one topic that surveyed farmers in the study area indicated that they need advisory. The use of social media among the surveyed farmers and the Somali population, in general, has increased. As such, there is a potential that social media can be used to share information on agricultural topics and raise awareness among the advisory stakeholders to use digital extension services. Facebook, WhatsApp, and Imo are the main social media apps identified in the research area.

The findings of the study revealed that the necessary enabling conditions for the adoption and implementation of the smartphone-based advisory system in the study area exist. Furthermore, the study has also noted several determinant factors that could facilitate or hinder the potential use of the smartphone as an information delivery tool in the study area. Security issues and internet connectivity are the main external challenges that could constrain the potential use of the service. On the other hand, a number of internal and external opportunities that could facilitate the optimal use of the service were also identified.

The results of this study indicate that it is feasible to use smartphones as a tool for information delivery and recommends for the potential information providers to target the farmers who already have access to smartphones since it is a best-suited tool when it comes to delivering location-specific answers to the farmers and it will also enable two-way information flow.

The exploratory nature of research revealed several topics that need further research concerning smartphone-based advisory service in the study area. Additional study will need to be carried out to determine ways to link farmers that have access to a smartphone to agricultural institutions and if smartphones will increase connectivity between the extension agents and farmers in the study area context and finally, to establish whether linking information providers and information users via smartphone will fill the current information gap that exists in the study area.

References

Abukar, M. A., 2019. *Dr.* [Interview] (15 July 2019).

AfDB, G., 1988. *THE AGRICULTURAL EXTENSION AND FARM MANAGEMENT TRAINING PROJECT-SOMALIA,* s.l.: AFRICAN DEVELOPMENT BANK GROUP.

Alex, G. et al., 2000. *Decentralizing agricultural extension: Lessons and Good practice,* s.l.: World Bank.

Allahyaria, M., Atashi, M., Dunn & E, 2018. Feasibility of Using Mobile Phones as an Educational Medium in Agricultural Extension Services in Guilan Province, Iran. *Journal of Agricultural & Food Information,* 19(2).

Altieri, M., 2002. Agroecology: the science of natural resource management for poor farmers in marginal environments. *Agriculture, Ecosystems & Environment,* 93(1-3), pp. 1-24.

Axinn, G., 1988. *Guide on Alternative Extension Approaches: Agriculture Education and Extension service.* Rome: FAO.

Axinn, G. H., 1998. *Guide on Alternative Extension Approaches.* S .l.: FAO.

Babu, S. & Joshi, P., 2019. Extension reforms in South Asia: Synthesis of conclusions, lessons learnt, and the way forward. In: S. Babu & P. Joshi, eds. *Agricultural Extension Reforms in South Asia: Status, Challenges, and Policy Options.* S .l.: Academic Press, pp. 369-375.

Bank, T. W., 2011. *ICT IN AGRICULTURE: Connecting Smallholders to Knowledge, Networks, and Institutions,* Washington, DC: The World Bank.

Bank, T. w., 2018. *https://www.worldbank.org.* [Online]
Available at: https://www.worldbank.org/en/news/press-release/2018/09/13/somalia-economic-update-rapid-growth-in-mobile-money
[Accessed 13 January 2019].

BBC, 2019. *https://www.bbc.com.* [Online]
Available at: https://www.bbc.com/news/technology-47416250
[Accessed 26 July 2019].

Bhattacharjee, S. & Raj, S., 2016. *Social media: Shaping the future of agricultural extension and advisory services,* Lindau: GFRAS.

Billings, L. et al., 2018. *External evaluation of mobile phone technology-based nutrition and agriculture advisory services in Africa and South Asia,* Oxford: s.n.

Bonke, V., Fecke, W., Michels, M. & Musshoff, O., 2018. Willingness to pay for smartphone apps facilitating sustainable. *Agronomy for Sustainable Development.*

Bourne, M. et al., 2017. A network perspective filling a gap in assessment of agricultural advisory system performance. *Journal of Rural Studies,* Volume 50, pp. 30-44.

CGIAR, 2019. *ACCELERATING CGIAR'S DIGITAL TRANSFORMATION,* s.l.: Accenture.

Chapman, N., 1987. The evolution of training and visit in Somalia. *Agricultural Administration and Extension,* 26(3), pp. 151-163.

Collier, P., 2003. *Breaking the conflict trap: Civil war and development policy.,* s.l.: World Bank.

Communities, C. o. t. E., 1975. *European Development Fund : Somalia 1960-1975,* Brussels : s.n.

Corbin, J. & Strauss, A., 2008. *Basics of Qualitative Research: Techniques and Procedures for Developing Grounded Theory.* 3rd ed. s.l.: SAGE.

Creswell, J. W., 2014. *Research Design: Qualitative, Quantitative, and Mixed Methods Approaches.* 4th ed. Thousand Oaks, CA: SAGE.

Davis, K., Bohn, A. & Franzel, S., 2018. *What Works in Rural Advisory Services? Global Good Practice Notes,* Lausanne: GFRAS.

Davis, K. et al., 2012. Impact of Farmer Field Schools on Agricultural Productivity and Poverty in East Africa. *World Development,* 40(2), pp. 402-413.

De Pauw, E. N. F. A. J., 1996. *A provisional world climatic resource inventory based on the length of growing period concept.* [Online]
Available at: https://library.wur.nl/isric/fulltext/isricu_i14812_002.pdf#page=43
[Accessed 21 February 2019].

De Vaus, D., 2001. *Research design in social research.* London; Thousand Oaks, New Delhi: SAGE.

Deichmann, U., Aparajita, G. & Deepak, M., 2016. *Will Digital Technologies Transform Agriculture,* s.l.: World Bank Group.

Dettmer, H., 2007. *The Logical Thinking Process: A Systems Approach to Complex Problem Solving.* Milwaukee: Quality Press.

Devereux, S., 2018. Food insecurity and famine. In: B. Tony, L. Kenneth & N. Etienne, eds. *Handbook of African Development.* 1 ed. London: Routledge, pp. 183-199.

Dishaw, M., Strong, D. & Bandy, D., 2002. *EXTENDING THE TASK-TECHNOLOGY FIT MODEL WITH SELF-EFFICACY CONSTRUCTS.* s.l., AIS Electronic Library (AISeL).

El Bilali, H. & Allahyari, M., 2018. A transition towards sustainability in agriculture and food systems: Role of information and communication technologies. *Information and Processing in Agriculture,* 5(4), pp. 456-464.

FAO, 2017. *Information and Communication Technology in Agriculture,* Rome: FAO.

Feder, G., Ganguly, S. & Anderson, J. R., 2006. *The rise and fall of training and visit extension: an Asian Mini-drama with an African epilogue,* s.l.: The world bank.

FSNAU, 2013. *SUBSISTENCE FARMING IN LOWER SHABELLE RIVERINE ZONE,* s.l.: FAO.

Gaas, M., 2018. *Order in Chaos: Understanding Governance in Somalia (Ph.D.) Thesis,* Ås: Norwegian University of Life Sciences.

Gaaya, A., 1994. *Extension education in agricultural and rural development: Role of international organizations,* Montpellier: CIHEAM.

Garforth, C., Angell, B. & K., G., 2003. Fragmentation or creative diversity? Options in the provision of land management advisory services. *Land Use Policy,* 20(4), pp. 323-333.

Ghaffari, K., Delgosha, M. & Abdolvand, N., 2014. TOWARDS CLOUD COMPUTING: A SWOT ANALYSIS. *International Journal of Information Technology Convergence and Services,* 4(2).

Golafshani, N., 2003. Understanding Reliability and Validity in Qualitative Research. *The Qualitative Report,* 8(4), pp. 597-606.

Group, W. B., 2018. *http://documents.worldbank.org.* [Online]
Available at:
http://documents.worldbank.org/curated/en/975231536256355812/pdf/REPLACEMENT-PUBLIC-Somalia-Economic-Update-3-FINAL.pdf
[Accessed 29 January 2019].

Hall, A. J. et al., 2004. *Innovations in innovation: reflections on partnership, institutions, and learning.* New Delhi: ICRISAT.

Hamad, A., Eltahir, M., Ali, A. & Hamdan, A., 2018. *Efficiency of Using Smart-Mobile Phones in Accessing Agricultural Information by Smallholder Farmers in North Kordofan – Sudan.* [Online]
Available at: https://papers.ssrn.com/sol3/papers.cfm?abstract_id=3240758
[Accessed 21 May 2019].

Hesse-Biber, S., 2010. Qualitative Approaches to Mixed Methods Practice. *Qualitative Inquiry,* 16(6), pp. 455-468.

Howdle, D., 2019. *https://www.cable.co.uk/.* [Online]
Available at: https://www.cable.co.uk/mobiles/worldwide-data-pricing/
[Accessed 23 July 2019].

Irungu, K., Mbugua, D. & Muia, J., 2015. Information and Communication Technologies (ICTs) Attract Youth into Profitable Agriculture in Kenya. *East African Agricultural and Forestry Journal,* 81(1), pp. 24-33.

Jamac, M., 2019. *Mr.* [Interview] (6 July 2019).

Janssen. S. J. et al., 2017. Towards a new generation of agricultural system data, models and knowledge products: Information. *Agricultural Systems,* Volume 155, pp. 200-212.

Jimale, A., 2016. *Feasibility study for vegetable production, Marketing, And processing in Lower Shabelle region Somalia,* s.l.: Thesis.

Kabbiri, R., Dora, M., Elepu, G. & Gellynck, X., 2018. Mobile phone adoption in the agri-food sector: Are farmers in Sub-Saharan Africa connected?. *Technological Forecasting and Social Change,* Volume 131, pp. 253-261.

Kansiime, M. et al., 2019. Effectiveness of mobile agri-advisory service extension model: Evidence from Direct2Farm program in India. *World Development Perspectives,* Volume 13, pp. 25-33.

Kelly, M., 2013. NGOs, Pluralism, and Advisory Services—Timor Leste. *The Journal of Agricultural Education and Extension,* 19(2).

KOCIJANC, M. & PUGLISI, D., 2019. *https://eeas.europa.eu/.* [Online]
Available at: https://eeas.europa.eu/delegations/kazakhstan/62812/remarks-high-representativevice-president-federica-mogherini-press-point-hassan-ali-khayre_ar
[Accessed 23 Aug. 2019].

Kumar, P. & Ratnakar, R., 2016. A scale to measure farmers' attitudes towards ICT-based extension services. *Indian Research Journal of Extension Education,* Volume 21, pp. 109-112.

Lai, P., 2017. THE LITERATURE REVIEW OF TECHNOLOGY ADOPTION MODELS AND THEORIES FOR THE NOVELTY TECHNOLOGY. *Journal of Information Systems and Technology Management,* 14(1).

Lee, Y., Kenneth, A. & Larsen, K., 2003. The Technology Acceptance Model: Past, Present, and Future. *Communications of the Association for Information Systems,* Volume 12.

Liou, D. K., Chih, W. H., Hsu, L. C. & Huang, C. Y., 2016. Investigating information sharing behavior: the mediating roles of the desire to share information in virtual communities. *Information Systems and e-Business Management,* 14(2), pp. 187-216.

M.C., P., Finlayson, B. & McMahon, T., 2007. Updated world map of the Koppen-Geiger. *Hydrology and Earth System Sciences Discussions,* Volume 4, p. 439–473.

Majid, N. & McDowell, S., 2012. Hidden dimensions of the Somalia famine. *Global Food Security,* 1(1), pp. 36-42.

Maxwell, D. & Fitzpatrick, M., 2012. The 2011 Somalia famine: Context, causes, and complications. *Global Food Security,* 1(1), pp. 5-12.

Munthali, N. et al., 2018. Innovation intermediation in a digital age: Comparing public and private new-ICT platforms for agricultural extension in Ghana. *NJAS-Wageningen Journal of Life Sciences.,* Volume 86-87, pp. 64-76.

Murari, S., 2011. *Evaluation of Agricultural Extension and Advisory Services,* s.l.: Michigan State University and the MEAS Project.

Naruka, P. S. et al., 2017. A study on the role of WhatsApp in agriculture value chains. *Asian Journal of Agricultural Extension, Economics & Sociology.,* 20(1), pp. 1-11.

Peterson, W., 2006. *http://www.fao.org/.* [Online]
Available at: 06fao.org/3/w5830e05.htm
[Accessed 14 October 2019].

Pherali, T. & Lewis, A., 2019. Developing global partnerships in higher education for peacebuilding: a strategy for pathways to impact. *Higher Education,* 78(4), pp. 729-744.

Qumer, S. & Singh, G., 2019. TECNO Mobile's Growth Strategies in Africa. *China-Focused Cases,* pp. 81-101.

Rao, S., 2018. Using radio in agricultural extension. In: *What Works in Rural Advisory Services?.* Lausanne: GFRAS, pp. 99-102.

Rivera, W. & Alex, G., 2004. *Demand-Driven Approaches to Agriculture Extension.,* Washington, DC: The World Bank.

Sandra, P., 2001. GROWING MORE FOOD WITH LESS WATER. *Scientific American,* 284(2), p. 46.

Saravanan, R. & Bhattacharjee, S., 2014. Global Review on Mobile Phone Applications for Agricultural Extension. In: R. Saravanan, ed. *Mobile Phones for Agricultural Extension.* New Delhi: New India Publishing Agency, pp. 1-75.

Schiere, J., Groenland, R., Vlug, A. & Van Keulen, H., 2004. *System thinking in agriculture: An overview,* s.l.: s.n.

Schwartz, L. & Kampen, J., 1992. *Agricultural Extension in East Africa,* Washington, D.C.: World Bank.

Senger, I., Borges, J. A. R. & Machado, J. A. D., 2017. Using the theory of planned behavior to understand the intention of small farmers in diversifying their agricultural production. *Journal of rural studies,* Volume 49, pp. 32-40.

Shalal, A., 2019. *https://www.reuters.com/.* [Online]
Available at: https://www.reuters.com/article/us-imf-worldbank-somalia/somalia-aims-to-reduce-poverty-pump-up-infrastructure-after-debt-erased-idUSKBN1WZ0ON
[Accessed 28 October 2019].

Shemfe, O. A. & Oladele, O. I., 2018. EXTENSION OFFICERS' PERCEPTION TOWARDS ACCREDITATION AND REGULATION OF EXTENSION SERVICES IN NORTH WEST PROVINCE, SOUTH AFRICA. *South African Journal of Agricultural Extension,* 46(1), pp. 44-58.

Silverman, D., 2006. *Interpreting Qualitative Data: Methods for Analyzing Talk, Text, and Interaction.* 5th ed. s.l.: SAGE.

Sommer, C. & Schneider, W. J., 1996. *The living marine of Somalia.* S .l.: FAO.

TeleGeography, 2018. *https://www.telegeography.com.* [Online]
Available at:
https://www.telegeography.com/products/commsupdate/articles/2018/11/06/somtel-expands-services-to-mogadishu/
[Accessed 14 June 2019].

Thakur, D. & Chander, M., 2018. Use of social media in agricultural extension: Some evidences from India. *International Journal of Science, Environment and Technology,* 7(4), pp. 1334-1346.

Tongco, M. D. C., 2007. Purposive sampling as a tool for informant selection. *Ethnobotany Research and applications,* Volume 5, pp. 147-158.

Tsan, M., Totapally, S., Hailu, M. & Addom, B. K., 2019. *The Digitalisation of African Agriculture Report 2018–2019..* s.l.: CTA.

UNFPA, 2014. *POPULATION ESTIMATION SURVEY OF SOMALIA,* NAIROBI: UNON.

USAID, 2014. *Assessment Report SOMALIA ECONOMIC GROWTH STRATEGIC ASSESSMENT,* Washington, DC: USAID.

Valenzuela, J. et al., 2017. Oxidative stress associated with chilling injury in immature fruit: postharvest technological and biotechnological solutions. *International Journal of Molecular Sciences,* 18(7).

Wallace, M. & Wray, A., 2011. *Critical Reading and Writing for* Postgraduates*.* 2nd ed. s.l.: SAGE.

Wanglin, M., Grafton, R. & Renwick, A., 2018. Smartphone use and income growth in rural China: empirical results and policy implications. *Electronic Commerce Research,* pp. 1-24.

Vargas, R., Omuto, C. & M.S, A., 2017. *Soil survey of the juba and Shabelle riverine areas in southern Somalia,* s.l.: SWALIM.

Webersik, C., 2005. Fighting for the Plenty: The Banana Trade in Southern Somalia. *Oxford Development Studies,* 33(1), pp. 81-97.

Venema, J., 2017. *Land resources assessment of Somalia. Technical Project Report L-12,* Nairobi: FAOSWALIM.

Von Blanckenburg, P., 1982. Basic concepts of agricultural extension in developing countries. *Agricultural Administration ,* 10(1), pp. 35-43.

World Bank, G., 2015. *https://www.worldbank.org/.* [Online]
Available at:
https://www.worldbank.org/content/dam/Worldbank/document/Africa/Somalia/somalia-economic-update-october-2015.pdf
[Accessed 12 January 2019].

Wright, H. et al., 2016. Using ICT to Strengthen Agricultural Extension. *Journal of Agricultural & Food Information,* 17(1), pp. 23-36.

Wu, J. et al., 2018. Information and Communications Technologies for Sustainable Development Goals: State of the art, Needs, and Perspectives. *IEEE COMMUNICATIONS SURVEYS & TUTORIALS,* 20(3), pp. 2389-2406.

APPENDIX

Appendix 1: Afgooye District Map (Data source: UNDP)