UNIVERSITY OF CAPE COAST

MOBILE PHONE ADOPTION FOR MARKETING INFORMATION BY SMALLHOLDER FOOD CROP FARMERS IN ASSIN NORTH DISTRICT OF GHANA.

PIUS MENSAH

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BY

PIUS MENSAH

Thesis submitted to the Department of Agricultural Economics and Extension of the School of Agriculture, College of Agriculture and Natural Science, University of Cape Coast, in partial fulfilment of the requirements for the award of Master of Philosophy Degree in Agricultural Economics

OCTOBER, 2022

DECLARATION

Candidate's Declaration

I hereby declare that this thesis is the result of my own original research and that no part of it has been presented for another degree in this university or elsewhere.

Candidate's Signature: …….. Date: …….

Name: Mensah Pius

Supervisor's Declaration

I hereby declare that the preparation and presentation of the thesis was supervised in accordance with the guidelines on thesis laid down by the University of Cape Coast.

Supervisor's Signature: …… Date: ……..…….

Name: Dr. William Ghartey

ABSTRACT

The study investigated the determinants that enhance the adoption of mobile phones for marketing information by smallholder food crop farmers in the Assin North District of Ghana. A multi-stage sampling technique was used to select 400 farmers from a total population of 69,678 food crop smallholder farmers in the Assin North District of Ghana. The study adopted cross sectional survey design. Data was collected using structured interview guide. Percentages, frequencies, mean, standard deviations, Kendall's coefficient of concordance, and binary logistic regression model were applied to analyse the data. The study concluded that younger smallholder food crop farmers who are male with higher number of years in schooling and are active participant of Farmer Based Organisations (FBOs) have a greater tendency to adopt mobile phones for marketing information. Also, smallholder food crop farmers who have higher access to extension services, lower farm experience, higher annual income and larger farm size have a greater tendency to adopt mobile phones for marketing information, which encouraged timely and accurate marketing information and improves yield and sales of output. Difficulties in the use of the internet was the most limiting constraint in the use of mobile phones to access marketing information. The study recommends that mobile phones can be used in conjunction with other AMITs, but they are not a complete substitute. Also, through stakeholders (donor agencies, policy makers, and district Ministry of Food and Agriculture department) extension officers and FBOs can be empowered to create an enabling environment to attract especially female smallholder food crop farmers. Intensive education on the usage of the internet is needed to make smallholder food crop farmers' internet usage friendly. Also, government and internet service providers may prioritize infrastructure development to ensure reliable and high speed internet connectivity reaches small holder food crop farmers. This may be done by investing in technology like fibre optic or satellite internet.

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DEDICATION

To my lovely mother, Gifty Mensah and my sisters, Wilhelmina Mensah and Sophia Ghann

TABLE OF CONTENT

Contents

LIST OF TABLES

TABLE **PAGE**

LIST OF FIGURES

LIST OF ABBREVIATIONS

AIC	Agricultural Information Centers
AMIS	Agricultural Marketing Information Systems
AMITs	Agricultural Marketing Information Tools
ANMA	Assin North Municipal Assemblies
FAPDA	Food and Agricultural Policy Decision Analysis
FBO	Farmer Based Organisation
FOASTAT	Food and Agriculture Organization Corporate Statistical Database
GSS	Ghana Statistical Service
GFS	Global Food Security
ICT	Information Communication Technology
IFAD	International Fund for Agricultural Development
MIS	Marketing Information System
MIT	Marketing Information Tools
MoFA	Ministry of Food and Agriculture
NCA	National Communication Authority
NGO	Non-governmental Organization
SMS	Short Message Service
TAM	Technology Acceptance Model
USAID	United States Agency for International Development
WAAPP	West Africa Agricultural Productivity Program

CHAPTER ONE

INTRODUCTION

Agricultural Marketing Information Tools (AMITs) are technologies that help to gather, process, and distribute information based on the conditions and dynamics of agricultural markets to various stakeholders to aid in decision-making. However, the ubiquitous mobility feature of mobile phones gives rise to a lucrative option comparatively to other AMITs. Therefore, there is the need to facilitate mobile phone adoption for improvement in the participation of diverse markets by smallholder farmers in developing countries, which may carry the potential of increasing sales.

Background to the Study

At the global level, agriculture plays a critical role in the improvement of nations' economies by providing employment to rural populations as well as food (FAO, 2014). Despite making up a minor portion of global economic output, agriculture employs close to 30% of all workers worldwide (FOASTAT, 2018). Generally, agriculture's contribution to total GDP is highest in countries in Africa and South Asia, and it is seen as the backbone of these economies. It also provides basic ingredients to mankind and raw materials for industrialization (FAO, 2014). Food is something that everyone in the world needs (WFP, 2009).

In light of this, agricultural food production contributes to an essential duty in the provision of food for all nations around the globe (FAO, 2014). In spite of high population growth in nascent and developing countries, the consumption rate

for food grows at a faster rate in relative terms, and if not met, the rising need for food products will influence the rate at which an economy grows and also bring about food security issues (IFAD, 2011). Agriculture provides a living for 75% of Africans who live in rural areas (FAO, 2014). Unfortunately, Africa's rural areas contain the highest proportion of impoverished people, which is partially due to the ineffective marketing of farmers' agricultural products (FAO, 2014). Therefore, the quest to reduce poverty should gear towards the transformation of the agricultural sector. Specifically, maintaining improvement in the marketing of agricultural produce will improve the rate of output per unit of input facilitated by a lucrative market.

Knowledge, coupled with accurate and timely information, has become the major driver of agricultural marketing transformation in the world. Knowledge, skills, and information need to be intensified to facilitate the marketing of agricultural produce (Hung-Jae, 2020). The availability of markets and market information, knowledge, and skills offers farmers a bargaining advantage that increases income (Odoom, Anning-Dorson, & Acheampong, 2017). Approximately 650 million mobile phone customers are registered on the African continent. Africa is now the world's second fastest growing mobile market, after Asia (Razaque & Sallah, 2013). Making good decisions in agriculture requires the use of timely and reliable information, especially for smallholder farmers. This expanding importance is due in part to developments in communications technology and quickly changing farming techniques (Gallowa & Mochrie, 2015), and in part to climate change.

Numerous challenges have evolved in agricultural food production, including new illnesses and pests, shifting growing seasons, and extended droughts. Farmers, particularly smallholder farmers, have suffered as a result. Effective information sharing is required for farmers to cope with these issues. Since 2001, Ghana's development initiatives have aimed to revitalise the agricultural sector through the modernization and commercialization of smallholder agriculture (FAO, 2014). Enhancing agricultural sector reforms was encouraged through the deployment and utilisation of ICTs to increase the sector's efficiency in production. Privatization of the telecommunications business, development of a governing entity, and infrastructural investments such as an internet infrastructure and mobile phone flagpole are among the initiatives made to improve investments in ICT deployment. Community Information Centres (CICs) have also been established in various areas to promote large-scale ICT training. The function that ICT-based information delivery systems may play in transferring rural farmers with expertise and information serves as a driving force behind its significance. Exposure to market data can increase farmers' access to markets by enabling them to better bargain and meet market demands (Barrett & Carte, 2013).

To give smallholder farmers access to market data, the Sustainable Enterprise Development Foundation (SEND Foundation), a nongovernmental organisation based in northeast Ghana, launched the TradeNet market intelligence network in 2006. Farmers were specifically trained to use text message alerts received via mobile phones to gather and deliver market information. Before this project, the SEND Foundation supported local cooperative credit unions and

agricultural activities to increase food security (Akudugu, Guo, & Dadzie, 2012). According to Darkwaah (2018), Ghana's small-scale farmers consistently struggle to gain access to the knowledge, abilities, and marketing data that could increase their revenue. The government has made a lot of efforts to encourage AMIT use among smallholder farmers to allay this anxiety. AMIT initiatives have been widely proposed to advance the commercialization of agricultural products. The government attempted to encourage the sharing of agricultural marketing information with farmers. However, it wasn't effective since the policy objective was not met (Fafchamps & Minten, 2012). One important strategy to raise smallholder farmers' income is to keep them better informed about marketing information (Wyche & Steinfield, 2016).

Problem Statement

Ghana, a middle-income nation in West Africa, is undoubtedly a country that depends heavily on agriculture (Lowder, Skoet, & Raney, 2016). The south-western part of the country has been fueled by agricultural expansion and predominantly employs small-scale farmers who grow both cash and food crops (MoFA, 2014). Major progress has been made in agricultural development as a result of high mobile phone penetration (GMSA, 2020). According to Wyche and Steinfield (2016) and Darkwaah (2018), this AMITs tool helps gain access to timely and accurate marketing information and hence improves the sales of smallholder farmers. However, the Assin North district, characterised by numerous smallholder food crop farmers and a high mobile phone use population (GSS, 2020),

experiences limited access to market information, knowledge, and skills, and that has posed a major challenge in the creation of a successful marketing system.

It is widely acknowledged that ICTs, particularly mobile phones, may be used to boost access to and use of timely and accurate agricultural information (Nakasone, Torero & Minten, 2014). Mobile phones are a more effective tool than alternatives like television, newspapers, or radio, although they have not been the sole driver of the agricultural ICT revolution (World Bank, 2012). Assin North district in the central region has a large concentration of small-scale food crop farmers (MoFA, 2020). Generally, limited access to market information and knowledge often leads to exploitation by middlemen, which might affect their ability to manage their inventory and destabilise their risk pattern, culminating in excessive post-harvest losses, which in turn translates into a decline in income (Tadesse & Bahiigwa, 2015).

Although private organizations (SEND Foundation) and the Ghanaian government through the Ministry of Food and Agriculture and has vigorously encouraged the use of AMITs over the past ten years, the use of AMITs by smallholder food crop farmers for marketing information is not very great in quantity, range, or degree (Darkwaah, 2018). In a study conducted by Sokoya and Alabi (2017) to determine the elements that influence the adoption of mobile phones, the researchers mainly focused on perceived usefulness and usability as the key indicators of the adoption of mobile phones to access marketing content. However, according to the Technology Acceptance Model, perceived usefulness and perceived ease of use have a lower explanation index for technology adoption

(Muchran & Ahmar, 2019). Numerous factors, including participant type and research environment, have an impact on the model's explanatory ability (Muchran & Ahmar, 2019).

Additionally, by including external variables or expressly investigating how those variables directly affect the adoption of technology, the Technology Acceptance Model's explanatory power can be increased (Burton-Jones & Hubona, 2016). The influencing factors for the adoption of mobile phones are context-dependent (Hung Jae, 2020). Therefore, there is a need for contingent analysis. However, not much attention has been given to other factors (socio-economic, demographic, situational, institutional, and cultural) to facilitate smallholder food crop farmers' use of mobile devices in marketing. There is a paucity of information on these factors, hence this study has been designed to close this gap.

The Purpose of the Study

The main purpose of this study is to estimate the determinants of mobile phone adoption for marketing information by smallholder food crop farmers in the Assin North District in the Central Region of Ghana.

The specific objectives are

1. To identify and describe the IMITs used by smallholder farmers to access information for marketing food crops in the study area.
2. To estimate factors that influence the adoption of mobile phones for marketing information by smallholder farmers in the study area.
3. To assess the extent of mobile phone use for marketing information in the study area.

4. To examine the constraints of the use of mobile phones by smallholder food crop farmers for marketing information.

Research Questions

1. What kinds of tools do smallholder farmers in the study area use to get information about how to market food crops?
2. What are the factors that influence the adoption of mobile phone for marketing information by smallholder food crop farmers who are engaged in selected food crops?
3. What is the extent to which smallholder food crop farmers use mobile phones for marketing information?
4. What are the challenges that smallholder food crop farmers face when using mobile phones to access marketing information?

Significance of the Study

The research's findings addressed the factors influencing mobile phone adoption for marketing in the study area. Decision-makers will use the findings to revamp the existing agricultural marketing information system and facilitate the delivery of relevant and robust information to farmers in order to improve their bargaining power in the sale of food crops and increase their income. This will help farmers to approach marketing problems with efficient solutions and make necessary and sufficient decisions.

Furthermore, the findings will advance our understanding of how smallholder farmers may market their products. It will also improve farmers' efficiency in food crop production in the study area and reduce poverty as farmers'

income earning capability will improve. Also, a decisive decision will be aided by the facts from this study for farmers, the government, and decision-makers in both public and private organizations. Researchers and students will be able to lay their hands-on empirical findings, which will aid in the literature review.

Delimitation

The study was conducted in the Assin North district of Ghana and will focus solely on the specific objectives set. A structured questionnaire in the form of an interview will be used in collecting the data.

Limitation

The central region's Assin North district served as the site of the study. The study's findings might not accurately reflect farmers in other regions since the influencing factors are context dependent.

The adoption of agricultural marketing technology, such as mobile phones, may affect farmers' livelihoods in many ways other than just sales improvement. However, the study can only look at the factors that affect how smallholder farmers use mobile phone marketing to increase their sales.

Also, the study was conducted in the Assin North district and did not cover all the crop enterprises undertaken by smallholder farmers in the study area. It is estimated that due to the huge nature of data collection for such a study and its financial implications on the researcher, it may hinder the progress of the study.

Definition of Terms

1. A farmer is someone who operates in agriculture, more specifically, someone who cultivates land or crops or raises animals like livestock or fish (Elly & Moore, 2013).
2. Smallholder farmers are small-scale farmers that cultivate one or two cash crops in addition to certain subsistence crops on privately held pieces of land that range in size from one hectare to four hectares. In the study, farmers having more than one hectare (up to four hectares) of land are called smallholder farmers (Chikuni & Kilima, 2019).
3. Adoption: the acceptance and use of something (Baumuller, 2012).
4. Food crops generally are crops that are grown for human consumption (Badu, Mensah & Kolavalli, 2007).
5. According to Mangstl (2018), e-Agriculture is a discipline that uses information and communication technologies (ICTs) in agriculture to improve both the lives of rural poor people and agriculture.
6. A mobile phone is a piece of technology that makes electronic information processing, transmission, and communication easier (Salau & Saingbe 2018).
7. Information communication technologies are those that enable the electronic collection, processing, storing, and delivery of information (Dziwornu, 2013)
8. The term "agricultural marketing" refers to a process that begins with the decision to create a commercial farm product and encompasses pre-

and post-harvest operations, assembly, grading, storage, transportation, and distribution (Wagh, 2018)

Organization of the Study

There are five chapters in the study. Chapter 1 contains the study's background, problem statement, investigation objective, research questions, and significance of the study, constraints, delimitations, terminology definition, and study organization. The study's second chapter examines the literature review, focusing mostly on the results of studies conducted by various researchers that are linked to the issue under consideration.

The research methods are the main topic of chapter three. It includes information on the research design, study area, population, sampling technique, data collection tools, data collection methods, data processing and analysis, and a chapter summary. The study's methodology and outcomes are covered in chapter four. In the fifth and final chapter, the summary, conclusions, and ideas for more research are talked about. The limitations of the study are also mentioned.

CHAPTER TWO

REVIEW OF RELATED LITERATURE

This chapter is structured to show what previous studies have looked at in terms of the adoption of mobile phones for marketing information. This is done to determine the extent to which past studies are related to the current study and to determine the relevant justification for additional research. The theoretical review, empirical review, and conceptual framework made up the literature review. The theories supporting the investigation were the main emphasis of the theoretical framework. The conceptual framework shows a visual framework of the study, illustrating the linkage between the variables, while the empirical review gives the findings of other writers. There was also a review of additional study-related subjects.

Review of Related Topics

A Brief History of e-Agriculture

By utilizing ICTs in the sector, e-Agriculture, a global society of practice founded by the World Summits on the Information Society in 2003 and 2005, seeks to improve food security and agricultural development (FAO, 2005). This worldwide network brings together individuals from all over the world to share knowledge, resources, and ideas through the use of ICTs for sustainable agricultural development (Mangstl 2018).

This global community is comprised of information specialists, farmers, researchers, students, corporate executives, development practitioners, and policymakers who are interested in enhancing policies and procedures regarding the use of information and communication technologies in support of sustainable agriculture in order to improve rural livelihoods (FAO, 2005). For ICTs to help agriculture and food security in a sustainable way, the global e-agriculture community needs to help people in rural development and agriculture share information and expertise, learn from each other, and set up ways to make decisions (FAO, 2005).

Sharing of Information

According to the various perspectives of the information demands by the end user, the dissemination of information entails the transmission of accurate and up-to-date information from senders, intermediates, and recipients (Sturgis, 2016). Making information available to a specific audience before they request it is known as information communication or dissemination (Mangstl, 2018). According to Zhang, Wang and Duan (2016), there are many methods for communicating agricultural information that are both available and in use. Distribution of timely, accurate agricultural information facilitates adoption of new agricultural technologies and enhances farming efficiency, which increases yields.

ICTs are thereby bringing about improvements that are opening up new opportunities by improving the use and presentation of revenue-generating technologies in numerous sectors, including agriculture (Fuller, Unwin, Felstead,

Jewson & Kakavelakis, 2012). According to Ali, Jabeen, and Nikhitha (2016), ICTs have the ability to disseminate pertinent information at the right moment, which enables farmers to make educated decisions, transforming agriculture into a successful company. The effective and efficient use of agricultural information by agricultural communities is facilitated by the timely delivery of information. ICTs make it possible to send up-to-date information to rural areas that are hard to reach.

Market Participation by African Smallholder Farmers

According to Tadesse and Bahiigwa, (2015), smallholder farmers in many developing African nations have low access to information and little market participation. According to Dioula, Deret, Morel, Vachat, and Kiaya, (2013), the reasons why farmers don't participate in the market as much are their isolation, low output, subpar agronomic methods, low prices, and lack of market knowledge. As lucrative markets frequently demand high-quality commodities, Magesa, Michael, and Ko (2014) discovered that farmers' inability to satisfy market criteria was a significant factor influencing market participation in Tanzania.

With respect to the study of Sekabira, Bonabana and Asingwire, (2012), Ugandan farmers' access to rural markets is restricted by their low-income levels. According to Tadesse and Bahiigwa (2015), smallholder farmers in many developing African nations have low access to information and little market participation. According to Dioula, Deret, Morel, Vachat, and Kiaya, (2013), the reasons why farmers don't participate in the market as much are their isolation, low output, subpar agronomic methods, low prices, and lack of market knowledge. As

lucrative markets frequently demand high-quality commodities, Magesa, Michael, and Ko (2014) discovered that farmers' inability to satisfy market criteria was a significant factor influencing market participation in Tanzania.

In the study of Sekabira, Bonabana, and Asingwire, (2012), Ugandan farmers' access to rural markets is restricted by their low-income levels. According to Katengeza, Okello, and Jambo (2011), transportation cost was a major factor influencing farmers' ability to access distant but higher-paying markets in Malawi. Similar impacts were shown in Ethiopia by Tadesse and Bahiigwa (2015), where high labor and transportation costs limited the involvement of low-income farmers in agricultural markets.

In accordance with Tadesse and Bahiigwa (2015), smallholder farmers in many developing African nations have low access to information and little market participation. According to Dioula, Deret, Morel, Vachat, and Kiaya (2013), the reasons why farmers don't participate in the market as much are their isolation, low output, subpar agronomic methods, low prices, and lack of market knowledge. As lucrative markets frequently demand high-quality commodities, Magesa, Michael, and Ko (2014) discovered that farmers' inability to satisfy market criteria was a significant factor influencing market participation in Tanzania.

Ugandan farmers' access to rural markets is restricted by their low-income levels (Sekabira, Bonabana, & Asingwire, 2012). Also, transportation costs were a major factor influencing farmers' ability to access distant but higher-paying markets in Malawi (Katengeza, Okella & Jambo, 2011). Similar impacts were shown in

Ethiopia by Tadesse and Bahiigwa (2015), where high labour and transportation costs limited the involvement of low-income farmers in agricultural markets.

Information System and Tools for Agricultural Marketing

According to Staatz, Kizito, Weber, and Dembele (2011), the Agricultural Marketing Information System (AMIS) is a collection of associations that gather data on market conditions, process and analyse the data to create marketing information, and then disseminate it to everyone through information channels. Again, market information systems may contain a variety of items. According to Staatz et al. (2011), these include data on prices, market circumstances, and clients.

In reference to Mahaliyanaarachchi (2013), marketing information includes details on potential market channels, product quality, target markets, and demand. Farmers, traders, government policy analysts and decision-makers, development organizations, input suppliers, banks, market information system staff, and researchers are additional stakeholders in the information system who either directly or indirectly express a need for products from the marketing information system. Market information services, according to Kizito, Donovan, & Staatz (2012), involve routinely gathering product prices from bigger markets, classifying them, storing them, and then communicating such data to other interested parties through established routes.

Again, Kizito et al. (2012) noted that there are various methods for stakeholders to share commodity prices using market information systems. Televisions, radios, emails, newspapers, the internet, mobile phones, and other gadgets are examples of effective dissemination tools. According to Shepherd (2017), the data that marketing systems frequently use may be divided into two

categories: current data and historical data. At the moment, stakeholder negotiations are most successful when current information is employed. However, as pointed out by Mahaliyanaarachchi (2013), marketing data is seen as a public utility in many developing countries. As a result, it is offered by a government agency and comes in a variety of shapes, from estimates and market analyses to displays of market pricing information.

Market Information Tools (MITs) are used by a variety of people (Porter, 2018). Additionally, historical data provided by marketing information gathered over time assists users in choosing or making judgments regarding which crops to raise and when to harvest. Cooperative marketing agents can make decisions about where to market their produce using previous market data. Financial institutions and other stakeholders or organizations utilize price data to monitor the economy's long-term health and determine the risk of lending to certain farmers. Government officials, academics, and decision-makers also examine changing marketing trends and track the state of food security using historical and current data.

According to Tollens (2016), the marketing information systems (MIS) were plagued by a lack of funding, officials' failure to compile reliable market data, and traders' refusal to provide information out of concern for taxes. However, one option to improve market openness is through the use of marketing information systems (MIS). Additionally, with liberalized marketplaces, market transparency is essential for making wise marketing decisions (Sumberg, Yeboah, Flynn & Anyidoho, 2017). It can be identified by the amount of knowledge value chain participants have regarding matters important to their decision-making (Tollens,

2016). Many rural farmers are underutilized because they are unaware of how prices have increased as a result of market liberalization (Badiane & Kherallah, 2012).

Supply of Agricultural Marketing Information Services in Ghana

Radio and television are crucial media for spreading information in Ghana. For instance, the International Marketing Plan (IMP, 2013) indicated that approximately one quarter of Ghanaians own a television and watch it on a regular basis. Extension agents can film demonstrations of novel techniques and enhanced varieties and broadcast them to farmers on television. Farmers can learn more about weather changes and crop production via programmes like the Wienco weather report.

Farmers rely minimally on television for market updates, according to (Chhachhar, Hassan, Omar, and Soomro, 2012). They further indicated that because such shows are not broadcast at the appropriate times, the majority of farmers are not motivated to look for agricultural information on television. As a result of this phenomenon, mobile services are now employed in agriculture to share and obtain information. There are initiatives that send text messages to farmers in the majority of the developing world with research and marketing information.

Mobile phones are the most widely used of these AMIT components because they enable information sharing at a cheaper cost than the others (Michaux, Hou, Karakochuk, Whitfield, Verbowski, and Green, 2019). Over time, there has been a noticeable increase in mobile phone usage. Mobile phone usage is increasing

as networks expand and costs decline (Houghton, 2009). In Africa, there were about 3.8 billion mobile phone subscriptions as of 2010, with a penetration rate of roughly 68%. Mobile communications provide improved assistance for the expansion of rural agriculture. With its help, smallholder farmers who find it difficult to get information through the current extension programmes can receive crucial information (Furuholt, 2011).

According to Sakyi, (2020), internet and radio communication technologies also greatly aid in the spread of information in Ghana. Ghana now has 100 internet service providers and 286 FM stations [National Communications Authority (NCA, 2012)]. In industrialized nations, internet use is more common to obtain precise information for the global market to reduce uncertainty in decision-making (Sekabira et al., 2012). The availability and use of modern AMITs among farmers improves information sharing and effective decision-making.

AMITs Service Providers in Ghana

In Ghana, a number of interventions have been implemented with the goal of disseminating sustainable agricultural information to improve farmer performance. These interventions include the creation of AICs, the E-commerce project, e-agriculture under the WAAPP, Esoko, and Farm radio. Following is an explanation of the examples.

The West Africa Agricultural Productivity Program (WAAPP)

The WAAPP, which was started by the Economic Community of West African States (ECOWAS), was supported by the World Bank and was intended to last for ten years in two phases, which ended in 2017. Three (3) African nations

(Ghana, Mali, and Senegal) were involved in the first phase, which lasted from 2007 to 2012, while thirteen (13) West African nations were involved in the second phase. Reviewing the WAAPP I revealed a number of achievements. However, it was discovered that the resources allocated for activities related to technology adoption and dissemination were insufficient, which is what prompted the Extension Services (DAES) to include technology dissemination in 2010 (MoFA, 2012).

The WAAPP team worked together to create a central hub for farmers, researchers, and agribusiness extension agents to connect and share information in order to establish and speed up the adoption of innovative technology in agriculture. Rural farmers who lack literacy have access to agricultural information via FM radio stations, town criers, and television shows where a large amount of agriculture-related programming is broadcast in their native languages.

The E-commerce Project

In 2002, as part of a nationwide effort to enhance the marketing of agricultural products, the Directorate of Agricultural Extension Services, MoFA, and the International Institute for Communication and Development (IICD) launched the E-commerce project (MoFA, 2014). This programme was launched to correct an imbalance in the number of extension officers to farmers across the country and to significantly improve the quality of communication at a low cost to farmers and other small business owners. It was implemented so that internet service consumers could easily get market intelligence to better inform their bargaining positions (MoFA, 2014).

MFarm Platform

According to Elrod and Moore (2012), MFarm is a wireless mobile phone application and web-based platform for sending and receiving data, for monitoring the activities of field agents and farmers to gather data on direct sales, and for monitoring operational stocks using mobile phones. Image-AD Limited created the platform to aid the International Fertilizer Development Center (IFDC) in carrying out their project. In Tamale, Ghana, the project was launch in 2012 (IFDC, 2012). The platform enables recognisable groups, associations, and organisations to provide support to their members who are dispersed throughout the operational areas. Mobile applications make up the platform (Java, Android, and web applications).

The platform has expertise in planning and production; checking for adherence to production procedures and timelines; sending extension messages via text messages and interactive voice response services; and estimating production costs. Using APIs, the mFarm synchronises with platform-developed modules. It quickly locates beneficiaries using the search and query features. The International Fertilizer Development Centre (IFDC) is explicitly addressing the issue of weak farmer-to-market links by enhancing farmers' earnings through the project "Linking Farmers to Markets (FTM)." The project provides technical information to farmers through mobile devices. The areas for the mobile platform have been mapped in the north and east (IFDC, 2012).

Farm Radio

Radio has been recognised as a useful tool for the dissemination of agricultural information and the promotion of agricultural extension in Ghana. Twenty radio stations in the Northern, Upper East, and Upper West Regions are receiving funds from USAID as part of its "farm radio" programme, which aims to educate farmers on best agricultural techniques. These broadcasters are linked to experts in the agricultural sector, including as those at the Ministry of Food and Agriculture (MoFA) and the many agricultural research institutions. Farmers in the audience call in to these shows to share their thoughts and ask questions.

Information Needs of Farmers

According to Bachhav (2012), information is the sixth necessity for human survival, right after air, water, food, and a safe place to live. Accordingly, it follows that knowing is a requirement for living. Every aspect of our lives is impacted by data. The dissemination of information to the relevant population at the proper time is essential if it is to be of any use or benefit to individuals, groups, or organisations in making decisions.

In reference to the study of Vakilzavareh, Lashgarara, and Mirdamadi (2014), information must be useful in order to be thought to be worth looking for. However, according to them, this relevance is inconsistent because people have varying opinions about the value of agricultural information based on their guiding principles, their surroundings, and their personal and societal circumstances. Information that is valued highly by one person or by a particular group of people may be viewed as useless in another context. Raeisi, Bijani, and Chizari (2018)

found that there are two key elements required for building information dissemination systems: reciprocal communication between people engaged and information that is focused on the requirements of farmers.

Studies on information needs help innovators create solutions that address the unique demands of end users (Mittal, Gandhi, & Tripathi 2010). The phrase "information needs" is frequently used and can signify a variety of things. The meanings include information needs, requests, wants, and desires. "A basic need for information that is valuable for one's private or social life" is characterized as "information" (Chisita 2010). Additionally, Chisita (2010) emphasizes how farmers' knowledge demands are shaped by the social and financial accomplishments of their group. For information to be deemed important, it must satisfy the needs of its intended audience. This means that information must be able to meet the demands or requirements of its intended audience in order to be considered valuable.

Utilizing information effectively and having the knowledge you need are crucial in agriculture since it plays a crucial role in the decisions that farmers make. Farmers will have an understanding of the weather conditions if information on a particular topic, such as current weather forecasting information, is made available to them. Armed with this awareness and knowledge, the farmers may then base their decisions on the newfound information. They will apply the knowledge to choose when and where to sow their crops. Therefore, it can be said that gathering the information needs of the target audience is crucial before developing a workable information system for disseminating essential information to a particular set of

individuals. The development of appropriate information programs, systems, policies, rules, and regulations in organisations depends critically on knowledge of the information needs of the target audience.

According to Babu, Glendenning, Okyere, and Govindarajan (2012), various studies on information requirements, wants, and preferences show that different regions and countries have different motivations for people to look for information. According to the Information Society Library (2013), "Finding out what people want from their information systems and services is an important first step in developing them, but it requires some digging." According to Meitei and Devi (2019), slow agricultural progress is a result of farmers' not getting the information they require in a timely manner.

According to Bachhav (2012) and Meite and Devi (2019), farmers' information needs differ depending on the level of development in a certain region or location. Meite and Devi (2019) stated that the information farmers give can be put into six groups.

- **Field acquisition:** This contains information on farming, including the many types of land and the methods for acquiring them.
- **Agricultural inputs:** This includes details on different kinds of seeds, insecticides, weather patterns, agricultural machinery, harvesting information, and technologies for after harvest.
- **Agricultural technology**: Information on cutting-edge agricultural technology is referred to agricultural technology.

- **Agricultural credit:** This data relates to credit and loan options available to farmers.
- **Agricultural market output:** This information relates to farming product markets and prices.
- **Food technology:** This material relates to technologies used after harvesting, which can help maximize the earnings from agricultural products.

Three primary needs were identified by Mittal, Gandhi, and Tripathi (2010) after studying Indian farmers on a nationwide scale.

- Knowledge that provides farmers with a basic understanding of farming practices.
- Market data, including information on input and commodity pricing, demand, transportation costs, and logistics.
- Contextual information, which provides details on the climate and the kinds of crops that thrive in specific climates and regions.

Furthermore, Mittal et al. (2010) noted that the three classes traverse through six segments and are necessary at various points throughout the six phases of farm life:

- Crop planning**:** Information about seeds and crops produced
- Prices of seeds and other inputs when purchasing them
- Planting: the ideal time to plant given the weather conditions.
- Growing**:** effective fertilizer application method

- Harvesting, packing, and storing: the ideal harvesting period based on the weather.
- Selling: determining the optimal pricing and delivery choices.

Facts about seeds, market prices, the climate, pest management, and the prevention of plant diseases are among the most vital pieces of data that farmers require. In a 2010 study (Mittal et al. According to research conducted by Babu et al. (2012), farmers who cultivate rice have a significant information gap in the areas of crop value, disease management, pesticide use, optimal planting window, fertiliser use, planting methods, seed treatment, and storage. According to a research, farmers in rural Tanzania require education in areas such as pest management, market prices, animal husbandry, input availability, soil fertility, diseases, crop husbandry, weather forecasts, crop diversification, livestock training, and innovative agricultural techniques (Elly & Silayo, 2013).

The Binary Logistic Regression Model

According to Tranmer and Elliot, (2018), logistic regression is a subset of "traditional" linear regression. Using binary logistic regression permits the evaluation of the "goodness-of-fit" between a set of predictor variables and a categorical outcome. When the dependent variable, Y, is categorical, the logistic regression formula is utilized. Binary logistic regression can be used when the Y variable is of the "Yes/No" variety. So that they may be expressed quantitatively, two categories of Y can be referred to as "1" and "0." However, the two categories can be anything (Tranmer and Elliot, 2018). The use of mobile phones for marketing purposes is a dichotomous dependent variable in this investigation.

When this occurs, standard linear regression (either simple or multiple) will not be appropriate.

Analysis of the Study's Theoretical Foundations

This chapter discusses the research's theoretical foundation. These theories include the Technology Acceptance Model (TAM), Theory of Planned Behavior (TPB), and Theory of Reasoned Action (TRA). Additionally, the importance of theories and the theoretical framework will be outlined.

A theory, according to Babbie (2010), is a methodical observation and justification of elements related to a specific life. In order to approach research problems logically, theories are employed as guides in the field of study. According to Babbie (2010), these ideas are crucial for research since they aid in avoiding flukes, explain trends found in data, and guide research efforts. According to Anfara and Mertz (2015), these theories have a significant impact on how researchers approach their work and permeate all areas of it.

The four key functions of a theoretical framework in research are described by Anfara and Mertz (2015) as follows: organizing and focusing a study; disclosing and hiding meaning and understanding; positioning the research in the academic discussion and providing a language; and disclosing the study's strengths and weaknesses.

Theory of Reasoned Action (TRA)

According to Sarver, (2013), there have been several notions presented that support user adoption of technology. One of the earlier theories created to explain technological acceptance in the field of psychology is the notion of reasoned action (Fishbein & Ajzen, 1980). The introduction of TRA theory has a

positive impact on the ability to anticipate, explain, and comprehend basic psychological factors of behavior in individuals. The individual rationality in nature is one of the theoretical presuppositions underlying TRA. As a result, the behavior will be related to the information available, with the major driver of an individual's behaviors being their behavioral intents (Ajzen and Fishbein, 1980).

According to TRA (Fishbein & Ajzen, 1975, as stated in Yousafzai, Foxall, & Pallister, 2013), the two primary factors in determining people's intentions are personal influence and societal influence. Personal orientation refers to the individual's positive or negative evaluations of the action performed, whereas social influence refers to the amount to which a person believes that individuals who are important to him or her presume that he or she should or should not carry out the act in question (Ajzen, 1985). In accordance with TRA, one's perspective on a certain behaviour is influenced by the most prominent beliefs one has concerning it. A person's performance outcomes can be directly linked to their own actions by keeping in mind these basic notions. Researchers found that whether or not smallholder farmers use mobile phones for marketing was related to their objectives (subjective norms and attitude).

Strength of the Theory of Reasoned Action

The volitional behavioural element represented in the TRA is the theory's strength. This is a behaviour that is planned out in advance in a person's mind before an action or occurrence occurs (Yousafzai et al., 2010). It is considered that smallholder food crop farmers in Ghana's Assin North District are sensible people who will make decisions based on reason, such as whether or not to use mobile phones for marketing.

The Theory of Reasoned Action's Drawbacks

Anticipating continuous or recurring conduct is limited using the concept of purpose (Das, 2014). But in this study, facilitating mobile phones for marketing purposes or not, is seen as a consistent behavior. To forecast an individual's ongoing behavior regarding the adoption of mobile phones or not, the identified determinants must be linked, which is where this theory fails.

Theory of Planned Behaviour (TPB)

Ajzen (2011) expanded his theory of reasoned action to include planned conduct in order to address the shortcomings of the first model. Perceived behavioural control was introduced to account for people's actions when under non-volitional influence. The degree of control people feel they have over engaging in an activity is known as perceived behavioral control (Hamilton & White, 2008).

When forecasting smallholder farmers' adoption of mobile phones, intention and perceived behavioural control are crucial. According to the TPB, whether or not smallholder farmers embrace mobile phones in the context of this study will rely on how much work they are prepared to put into the degree of control, such as knowledge, information, and skills (Carr & Sequeira, 2007).

Theory of Planned Behavior Restrictions

Firstly, TRA holds the assumption that an individual must be considerably motivated for an individual to perform a behavior. This assumption may lead to variations in adoption behavior because the presence of external barriers may prevent behavior execution (Carr & Sequeira, 2007).

Ajzen (2011) further noted that the three identified elements are not the only ones that influence intention (i.e., attitude, subjective norms, and perceived

behavioural control). Furthermore, empirical investigations revealed that TRA and TPB could only account for 40% of the variation in people's behavior. TPB was also criticised for combining all the non-controllable factors influencing people's behaviour into one variable, including age, sex, cultural values, etc. (Taylor & Todd, 2015).

Influencing factors of technology adoption goes beyond smallholder farmer's attitude, subjective norms and perceived behavioral control. According to the findings of Hung-Jae (2020), Abebe & Mammo Cherinet (2019), external factors such as situational, cultural, socio economic, institutional, and demographic factors also influence the adoption of a technology.

Technology Acceptance Model (TAM)

Davis's (1986, 1989) Technology Acceptance Model (TAM) is an extension of TRA that predicts a person's adoption of information technology (Figure 1 below). TAM says that two beliefs affect a person's intention to use technology: 1) perceived usefulness (PU), which is defined as "the extent to which a person believes that using a particular system would improve his or her job performance," and 2) perceived ease of use (PEOU), which is defined as "the extent to which a person believes that using a particular system would be free of effort" (Davis, 1989).

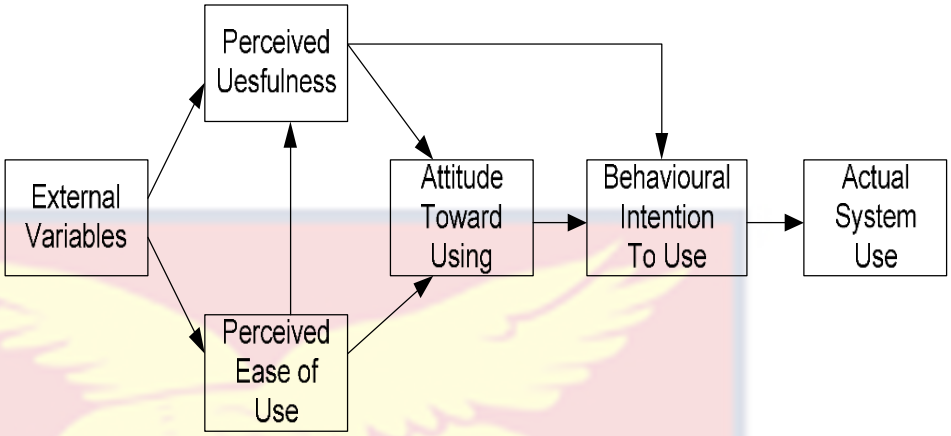

Figure 1: Technology Acceptance Model (TAM)

Source: Davis et al., (1989)

Over the past 20 years, the Technology Acceptance Model has received support and empirical validation (Liu, 2010). Venkatesh and Bala (2008) claim that TAM can reliably account for 40% of the diversity in people's intentions. TAM is also concerned with the features of the system that will affect individual acceptance. Figure 1 shows the TAM's first model, but Davis et al. (1989) say that the final model didn't include attitude.

1. The association between attitude and behavior is less substantial than the relationship between perceived usefulness and behavior.
2. It is not possible for attitude to totally moderate the link between perceived usability and behavioral intention.

Davis and Venkatesh (2006) noted that the individual's behavioural intention will be influenced by the external variables through perceived usefulness and ease of use, such as system design qualities and computer self-efficacy.

Adoption, validation, and extension are the three primary stages that make up the development of TAM (Suh & Han, 2013)

The Technology Acceptance Model's modesty was the focus of the adoption phase. Davis and colleagues set out to create a theoretically supported model that can forecast and justify a user's behavioral purpose in the setting of an information system (IS). The paradigm has been used with a variety of technologies during TAM development.

The validation phase serves to demonstrate the psychometric properties of the two primary components of TAM, perceived usefulness (PU) and perceived ease of use (PEOU). Davis (1989) developed a set of items for each of the two constructs to be measured. Examples of measures used to assess perceived usefulness and usability are shown in Table 1 as well (Suh & Han, 2013).

Construct	Measures
Perceived Usefulness (PU)	Individual job performance would improve as a result of the system The system would boost the person's efficiency The system would improve individual job performance The system would let the individual do activities more rapidly The system would make the task easier
Perceived Ease of Use (PEOU)	Learning how to use the technology would be easy It would be simple to get the system to do what is desirable It would be easy to be skillful at how to use the system. The system would be simple for me to utilize

Table 1: Examples perceived usefulness and perceived ease of use measures

Source: (Suh & Han, 2013).

From study to study, different numbers of items are employed to gauge perceived usefulness and perceived usability. Many researches have empirically verified and validated the majority of TAM's construct measures. For instance, Davis et al. (1989), using data collected from 107 MBA students at Michigan Business School, evaluated TAM using the word processing tool Write One. Perceived usefulness and perceived ease of use were each assessed using four measures in the study, and the findings indicate that the measures chosen have high levels of convergent and discriminate validity.

TAM has been studied extensively throughout time by including additional factors or moderating variables, as shown by the Extension Phase of TAM. First, Venkatesh and Davis (2006) and Venkatesh and Bala (2008) suggested two well-known extensions of TAM. Identification of factors that influence perceived usefulness was the first TAM extension (i.e. TAM 2). Five more variables subjective norm, image, relevance, output quality, and outcome demonstrability were added by Venkatesh and Davis (2006).

Four corporate organizations were used by the authors to examine the extended model. The findings indicated that perceived usefulness was the main factor influencing behavior. The primary goal of the second extension was to suggest determinants of perceived usability (TAM 3). Computer self-efficacy, perception of external control, computer anxiety, computer playfulness, perceived enjoyment, and objective usefulness were the characteristics put forth by Venkatesh and Bala (2008). The extended model gained more depth and insight by combining the determinants of the second and third models (Venkatesh and

Bala, 2008). However, the explained variance in behavioral intention was where the TAM model outperformed TAM 2 and TAM 3.

Additionally, the moderating variables' role is to detect the situational variations in order to explain the model's discrepancies (Sun and Zhang, 2016). Eight models were studied by Venkatesh, Morris, Davis and Davis, (2013), and their findings showed that adding moderating variables considerably improved the predictive validity of six of the eight models.

Additionally, Chin, Marcolin, and Newsted, (2013) findings confirmed the moderating variables' significance effect on technology acceptance models. Age, gender, computer experience, and voluntariness were identified by Venkatesh et al. (2013) as the four moderators that were most frequently utilized in technology acceptance studies.

The External Variables Identification

To address the specific environment of the research is the primary priority when identifying external variables in technology acceptance research (Musa, 2016). This necessitates a deeper comprehension of the potential factors that can affect IT adoption; these factors can be utilized to expand the TAM model and address the particulars of the research. The environment was primarily addressed by the external variables because the early applications of TAM were conducted in business organizations. For instance, to broaden TAM in a corporate setting, Venkatesh and Davis (2006) highlighted external elements like image, job relevance, and output quality.

Additionally, Venkatesh and Davis (2006) noted that it is necessary to hypothesize the link between the model variables in order to assess the impact of external variables on TAM components (i.e. perceived usefulness, perceived ease of use, and behavioural intention). The standard for technological acceptance study has been this approach to identifying the external variables (Padilla-Melndez & guila-Obra, 2013).

Literatures that offer empirical evidence of external variables impacting the adoption of mobile phones for marketing include Abebe and Mammo Cherinet (2019), Alavion et al., (2017), Kante et al., (2017), and Mittal and Mehar (2016). The use of mobile phones for marketing by smallholder food crop farmers can be supported by evidence when looking at external circumstances. demographic influences (e.g. Gender, age and education level) Farmers' socioeconomic factors include (farm size and income), Situational considerations, such as the distance between a farmer's home and a local market, their experience on the farm, and the distance between their home and an electricity source, The external variables influencing the adoption of mobile phones for marketing by smallholder food crop farmers include institutional factors of farmers such as farmers' participation in credit programs, membership in farmer-based organizations, and extension contacts by farmers; cultural factors such as cultural values; and religion.

Burton-Jones and Hubona, (2016) findings significantly indicate the direct influence of external variables on the adoption of mobile phones, which is the opposite of what Venkatesh and Davis (2006) claimed. His findings show that TAM's full mediation assumption is overestimated since external factors have a

large direct impact on technology adoption in addition to their influence on attitudes and beliefs (perceived usefulness and ease of use). Therefore, this study has been designed to examine the direct influence of external factors on the adoption of mobile phone for marketing food crops by smallholder farmers.

A study by Hsu and Lu (2015) discovered that although earlier research had identified perceived usefulness as a key predictor in the TAM model, this was not always the case, especially in online games that used technology for amusement rather than issue solving. Customers just use entertainment technology to pass the time and relax; as a result, the effect on users' perceptions of its usefulness is unaffected.

Burton-Jones and Hubona, (2016) came to the conclusion that the nature of the connection shouldn't be viewed as full or patial mediation but rather as a contingent mediation based on the type of technology and outside factors taken into account. To address the issue of limited access to timely and reliable marketing information, Hung-Jae (2020), Abebe, and Mammo Cherinet (2019) argued the necessity for a context-dependent analysis based on socio-economic, demographic, situational, institutional, and cultural aspects.

Technology Acceptance Model Limitations

The TAM model has limited explanatory ability, to start. A constant 40% of the variance in behavioral intention is explained by the model (Davis et al., 1989; Taylor and Todd, 2015; Venkatesh and Davis, 2006; Sun and Zhang, 2016). Moreover, the inclusion of external factors can increase the TAM's capacity for explanation (Hung Jae, 2020).

Second, the primary connections between TAM structures are erratic. For instance, some studies indicated that the association between perceived ease of use and behavioral intention was statistically significant (e.g. Davis et al., 1989; Venkatesh and Davis 2006; Heijden, 2014). Nevertheless, several investigations revealed that behavioral intention was not significantly influenced by perceived ease of use (Hong, Thong & Tam, 2016). Three factors system complexity, user experience, or gender, age can affect how easily something is perceived (Venkatesh et al., 2013).

Summary of the Theoretical Framework

The evolution of three models the Theory of Reasoned Action (TRA), the Theory of Planned Behavior (TPB), and the Technology Acceptance Model was examined in this chapter (TAM). In order to understand students' acceptance of e-learning systems, Davis (1989) developed the Technology Acceptance Model. Adoption, validation, and extension were the three stages of TAM development that were covered in the chapter. In addition, the chapter described the technique and factors that the earlier studies took into account when identifying the external variables. The chapter also discussed the limits of the TAM paradigm.

Empirical Literature

Empirical Studies on the Use of Kendall's Coefficient of Concordance

According to Codjoe, Brempong, and Boateng (2013), the limitations of the Cocoa-based Agriculture Knowledge Information System were analyzed utilizing Kendall's coefficient of concordance from the standpoint of cocoa growers in Ghana's Eastern Region (AKIS). The research showed that all of the ranking

limitations agreed on everything. This suggests that cocoa farmers are in agreement with the main obstacles to the effective operation of the agricultural knowledge information system for the cocoa-based economy. Few cocoa buying enterprises ranked the lowest among the fifteen limitations, with the result revealing that involvement with researchers and extension agents is insufficient. The highest mean score for this constraint was 4.57.

Adanu, Kuwornu, and Kwadzo (2019) investigated the economic viability of rubber production in Ghana's Ahanta West District. The Kendall's coefficient of concordance was used to look at the different restrictions put on performers. According to the study's findings, a high cost of labor was the most restrictive factor, with a mean score of 1.67. The District has a high labor cost since there are many small-scale mining operations there, which are thought to be more profitable than working on rubber plantations.

Empirical Review on Socio-Economic Determinant

According to a study conducted in India by Ali and Kumar (2011), the ability of farmers to make decisions was influenced by respondents' socio-economic category, income, land size ownership, and degree of education. Through the whole agricultural supply chain, the study found that farmers who used their cell phones for marketing information made better decisions.

Larkai (2019), studied resource allocation and crop diversification of smallholder farmers in the northern region of Ghana found that men typically dominate small-scale farming while women are primarily involved in harvesting. Also, the findings of Sumberg, Yeboah, Flynn, and Anyidoho (2017) who investigated the attitudes of young people on farming in Ghana and discovered that

young people believe there are alternative options, such as off-farm activities and also rural areas are not attractive.

The level of education a person has attained might range from primary school to junior high school, secondary school, and tertiary education. When having access to information and embracing new developments, the respondents' educational backgrounds and levels are crucial. The education levels of stakeholders do play a positive or negative role in how well any new technology is received. According to Dountio, Meukam, Tchaptchet, Ango, and Simo, (2016), having a high degree of education makes people feel more open to change and innovation. Furthermore, farmers' ability to navigate their phones and use them to get farming information depends in large part on their literacy level, which influences their use of mobile phones and, in turn, the adoption of these devices (Okello-Obura, Minishi-Majanja, 2018). Agricultural education and training have a direct impact on agricultural performance and output, however according to the literature, most farmers in Africa only have access to primary school (Aneani, Anchirinah, Owusu-Ansah, & Asamoah, 2012).

Okello et al., (2012) studied drivers of use of information and communication technologies by farm households and found out that smallholder food crop farmers are more likely to join Farmer-Based Organization influenced by lucrative incentives and benefit. Deichmann, Goyal, and Mishra, (2016), who studied on the topic digital technologies transform agriculture in developing countries and found that high family sizes boost family labour, which decreases labour cost in agricultural production.

Empirical Review on the Marketing Information Tools, Sources and Format Used by Smallholder Farmers to Access Information for Marketing

According to Hung-jae (2020), cereal smallholders look for marketing information from a variety of sources, including collectors, neighbors and friends, mobile phones, other producers, farmer unions, women's unions, extensionists, and cooperatives. These sources may be complimentary. This implies that no single information source can satisfy all of the smallholder grain farmers' information demands for selling. Hung-jae (2020) studied the use of mobile phone for marketing of cereals by smallholder farmers in Quang Dian District of Vietnam and found out that smallholder farmer's use mobile phones the most to get marketing information.

Chhachhar et al., (2012) studied the role of television in dissemination of agriculture information among farmers and also found that farmers rely minimally on television for market updates. They continued by saying that because such shows are not broadcast at the appropriate times, the majority of farmers are not motivated to look for agricultural information on television. As a result of this phenomenon, mobile services are now employed in agriculture to share and obtain information. Once more, the sole important element that influenced farmers' decision to pick TV was their contact with Extension. The extension officers helped them better grasp the television programs about the marketing of agricultural products. Mittal and Mehar, (2016); and Alavion et al., (2017), discovered that smallholders were not dependent on a sole source of information tool for marketing. Instead, they used a variety of sources.

The available and preferred formats of information, according to Mabika (2019), include print, voice, video, and SMS. Some respondents also mentioned MMS as an additional platform. Researchers have found a number of characteristics or criteria that affect how heavily agricultural marketing information tools are adopted (AMITs). Fawole (2008) discovered that among Nigerian pineapple farmers, four demographic factors age, sex, marital status, and education had an impact on farmers' sources of marketing information. He also noted that as farmers' educational levels rise, they become more likely to find and use marketing information systems. The farmers' primary instruments for evaluating marketing information were radio and newspapers.

Results from Mabika's (2019) research revealed that many sources and channels that respondents used to obtain agricultural information included extension staff, agricultural shows, field days, neighbors, friends, other farmers, the radio, the television, the internet, newsletters, and newspapers. Farmers who participated in the survey stated that they would be open to receiving updates of the same agricultural information via mobile phones in the future. The majority of respondents and stakeholders were found to be ignorant of sources for agricultural information transmission using mobile phones, such as Eco- Farmer, Kurima Mari, and Esoko. 57% of respondents according to a study by Mabika's (2019) said the proportion of farmers who obtain agricultural information via mobile phones only is low. The study came to the additional conclusion that WhatsApp groups rather than the existing agricultural information dissemination channels are where the few farmers who access agricultural information via their mobile phones.

Empirical Review on the Factors that Influence the Adoption of Mobile Phone for Marketing Information by Smallholders' Farmers

Abebe and Mammo Cherinet, (2019); Alavion, Allahyari, Al-Rimawi, and Surujlal, (2017); Kante, Oboko, and Chepken, (2017); Mittal and Mehar, (2016) reveal that the farmers' adoption of mobile phone for marketing is likely to be connected to either one, or more, of the following factors. Demographic factors of farmers such as gender, age and education level (Das, 2014; Mittal & Mehar, 2016; Senthilkumar, Chander, Pandian, & Kumar, 2013), Socio-economic factors of farmers and farms such as farm size, income and access to credit (Ogutu, Okello, & Otieno, 2014; Senthilkumar et al., 2013), Situational factors of farmers and farms such as distance from farmers' home to local markets (Abebe & Mammo Cherinet, 2019) and Institutional factors of farmers such as farmers' participation in training courses and extension contacts by farmers (Abebe et al., 2019; Senthilkumar et al., 2013).

Furthermore, there is a lack of consistency in the results reported in the published literature (Alavion et al., 2017; Kante et al., 2017; Mittal & Mehar, 2016). For instance, Mittal and Mehar (2016) looked into factors that affect Indian farmers' adoption of mobile phones for marketing and discovered that those with higher education levels and larger farms tended to use mobile phones for marketing more frequently than those with lower education levels and smaller farm size. Abebe and Mammo Cherinet (2019) used the same research methodology as Mittal and Mehar (2016) to examine how Ethiopian farmers use mobile phones for marketing. They discovered that better-educated and better-trained Ethiopian farmers have a greater tendency to use mobile phones for marketing than those who are not. The findings

of Bati, Gelderblom, and Van Biljon, (2014) report support the idea that mobile phone uptake and usage are influenced by culture. He claimed that a person's use of a technology is influenced by their religious upbringing.

Age has a significant impact on how people accept and use mobile phones, according to research. In their study, (Okello et al., 2012) found that younger people more easily pick up new technology than older people do, and that younger people also have a more positive attitude toward new technology. Contrary to popular belief, mobile phone use in agriculture is age-related (Okello et al. 2012). Falola and Adewumi (2012) found a negative correlation between the age of the household head and mobile usage. This is surprising because younger farmers are likely to be more familiar with mobile phones, but households with older heads may also be better able to buy them.

According to a study by Ohe, (2012) in Japan, farmers in that country have a favorable opinion of modern agricultural technology, but there are various things that could prevent them from adopting it. They claim that one of these important restrictions is age. Their findings demonstrate that young, educated farmers are more likely to adopt new technologies than older, more traditional farmers who place more stock in their prior successes. They claim that these older farmers are hesitant to adopt new technologies because they do not believe it would result in a large yield as they have been led to believe.

A high level of education positively persuades acceptance and a low level of education negatively influence acceptance. Ali, et al. (2016) establish that high level of education increases one’s personal feelings towards innovativeness and

change. Misaki, Apiola, Gaiani, and Tedre (2018) furthermore argued that the degree of education influences a person's understanding, adoption and access of new farming practices. The literacy level of farmers plays important role in their utilisation of cell phones to access farming information, and in navigating through their phones, thus, affecting their mobile phone usage and consequently, the adoption (Okello-Obura, 2018).

Hung-Jae (2020) showed that factors influencing mobile phone use for marketing included smallholders' age, gender, level of education, income, membership in CBOs, participation in credit programs, and the distance from their homes to the electricity grid. Additionally, it was discovered that the age of farmers had a negative statistical association with the use of mobile phones for marketing.

Furthermore, findings by Das, 2014; Mittal and Mehar, (2016); Senthilkumar et al., (2013) imply that young smallholders frequently use ICT. In contrast to Abebe and Mammo Cherinet's (2019) findings, which found that Ethiopian smallholders' use of ICTs for marketing was negatively associated with the distance between their homes and the electricity base, it was discovered that the adoption of mobile phones for marketing was positively associated with the distance between smallholders' homes and the electricity base.

Intriguingly, according to Hung-Jae (2020), his research revealed that smallholders' participation in FBOs had a substantial impact on whether they adopted mobile phones for marketing. More smallholder farmers who belong to FBOs use cell phones than those who do not. This can be related to the fact that FBO members frequently provide one another with financial and human resources,

which can provide them in a stronger position to embrace mobile phones for marketing and information exchange amongst members.

In general, studies that have examined the influencing factor on smallholder farmers' adoption of mobile phones so far show inconsistent and context-specific results (Tadesse & Bahiigwa, 2015; Sekabira et al., 2012). Results from various African nations differ due to regional differences in market dynamics, farmer literacy rates, and cell phone penetration rates.

Mobile Phone Use for Marketing Information and Smallholders' Traits

Hung-Jae (2020) found that among smallholder farmers in Vietnam's Quang Dien District, there was a significant relationship between the farmers' age, education level, and income and their likelihood of using mobile phones for marketing purposes. This suggests that different characteristics of individual smallholder farmers affect how they use their cell phones to sell cereal. It has been suggested that farmers' socioeconomic status influences their decision to use a mobile phone as a source of agricultural information (Aldosari, Al Shunaifi, Ullah, Muddassir, and Noor, 2019; Mittal and Mehar, 2016).

Empirical Review on the Price Variations of Food Crops Output Between Adopters and Non Adopters of Mobile Phone for Marketing Information

When selling food crops, there are differences in prices for mobile phone users and non-users. Hung-Jae (2020) asserts that smallholder farmers of food crops who used mobile phones were able to sell their goods for more money than those who did not. The findings of this study imply that the usage of mobile phones by smallholders for marketing has a favorable effect on the selling price of food crops

like rice and maize. Access to marketing data may be to blame for this. Additionally, Tadesse and Bahiigwa (2015) found that Ethiopian farmers with mobile phones receive higher selling prices for Teff and maize, though this finding was not statistically significant. Their findings partially supported those of researchers who looked into the use of mobile phones and farmers' marketing decisions.

Empirical Review on the Benefits of Mobile Phone Adoption for Marketing Information

Farmers acknowledged a number of advantages of mobile phones, citing "access to current information" and "enhanced connectivity with stakeholders" as the two most important advantages (Babar Shahbaz & Gao Qijie, 2019). These findings demonstrated how greatly updated knowledge has benefited smallholder food crop farmers. Some claim that farmers can now haggle with local marketplaces using their cell phones in order to sell their goods for more money (Tadesse & Bahiigwa, 2015). According to the literature, mobile phones have given farmers the means to connect with a variety of agricultural stakeholders, including traders, customers, and numerous institutions (Masuka, Matenda, Chipomho, Mapope, Mupeti, Tatsvarei, and Ngezimana, 2016).

On a contrary, Fitchett and Ebhuoma (2018) also noted farmers' dissatisfaction with the "usefulness of weather forecast" and "usefulness of expert comments" provided by mobile phones. Weather forecast refers to the distribution of weather updates and rain projections to farmers, whereas expert opinion refers to the emergency aid or help being supplied by farm advisory institutions and

organizations (via phone helplines or SMS services) to the farmers in the research areas. Farmers may find these services useless as a result of these restrictions, which can take the shape of inaccurate and unreliable weather forecast resources in the study area. Because they rely more on conventional wisdom and local climatic expertise, farmers may also perceive weather forecasts to be useless, according to the literature on this subject. For instance, farmers rely more on their local knowledge since they can forecast the onset of any drought or rainy season in many traditional civilizations and places by the shifting pattern of winds (Fitchett & Ebhuoma, 2018).

Empirical Review on the Extent of Smallholders' Adoption of Mobile Phone for Marketing Information

Hung-Jae (2020) discovered that the majority of smallholder farmers in Vietnam's Quang Dien District utilize mobile phones as one of their primary ICT tools for marketing crops. According to Toluwase and Apata's (2017) research, 9.2% and 44.2% of Nigerian farmers, respectively, use their mobile phones "very regularly" and "frequently" to access agricultural information. In Turkey, a study on agricultural market data systems was carried out by (Demiryurek, Erdem, Ceyhan, Atasever, & Uysal, 2018). The findings showed that farmers' revenue increased when they used mobile phone frequently. More European breeds could be kept, and each cow produced more milk. Akudugu et al., (2012), looked at how farm households in Ghana were utilizing contemporary agricultural production techniques. The study concluded that marketing information affected marketing choices and enhanced farm produce output.

Empirical Review on the Challenges Faced by Smallholder Farmers in Using Mobile Phones for Marketing Information

According to a study by Mabika (2019) on the use of mobile phones in Zimbabwe's Mashonaland West province to disseminate agricultural information to farmers, the study found that the main obstacles to using mobile phones to disseminate agricultural were high mobile data costs, high subscription fees for the platforms that were available to disseminate agricultural information, and high mobile phone costs. Another difficulty mentioned was a lack of connectivity. It is obvious that the respondents who complained about bad connectivity reside in places where there is no network coverage. The main constraints cited as limiting mobile phone access to agricultural information include high mobile phone expenses, data costs, and high subscription costs. A few respondents also listed language as a difficulty. Despite the fact that the majority of survey participants had access to mobile phones, a few respondents also cited this as another restricting factor.

Some smallholder farmers in rural areas have difficulties, such as mobile application delays or obstructions brought on by language barriers and illiteracy. According to a study in Ghana by Frimpong, Asare, & Otoo-Arthur, (2016), farmers use SMS less frequently since there is a higher percentage of illiteracy. Furthermore, Abebe and Mammo Cherinet (2019) discovered that the primary challenges Ethiopian farmers encountered while utilizing mobile phones for marketing were difficulty charging owing to the lack of electric power and high cost of buying mobile phones.

According to Darkwaah (2018), the difficulty of using the internet presents the main barrier to using a mobile phone, with roughly 61% and 28% of farmers in the Akwapim south district strongly agreeing and agreeing, respectively, with a mean score of 1.5. Furthermore, with 60% and 19% of the farmers agreeing and strongly agreeing with a mean score of 2.1, the low availability of mobile phone services in the district is the second most urgent barrier to using a mobile phone to get marketing information. Once more, farmers' inability to read and comprehend the information received is the third barrier to using AMITs to get marketing information. With a mean score of 3.5, around 32% and 25% of respondents strongly disagreed and disagreed with the information, respectively.

Conceptual Framework

A properly operating and efficient market depends on marketing information for decision making. AMITs are a class of technology created to collect, process, and disseminate information across one or more information channels to multiple stakeholders about the state and dynamics of agricultural markets to help them make decisions. Mobile phone, radio, Television, Newspaper etc are AMIT tools that helps in attaining timely and accurate marketing information to improve decision making. According to literature, mobile phone is considered the most effective and efficient AMIT characterized with ubiquitous mobility. Obviously, smallholder farmers may adopt or not adopt mobile phone for marketing. Therefore, there is the need to identify the determinants in other to enhance adoption of mobile phone for marketing.

Age, educational level, farm size, annual income, gender, farm experience smallholder farmers participation in credit programs, religion, cultural values, FBO

membership, distance from farm to local market and distance from farmers home to electricity base were posited as key variables influencing mobile phone adoption for marketing under this study. The Technology Acceptance Model (TAM) was adopted and modified to suit the study. With respect to this study, the external variables are being treated as direct influence on mobile phone adoption for marketing. According to Hung Jae (2020), examination of external factors best explains the adoption of mobile phone than the individual farmers' personal beliefs (perceived ease of use and perceive usefulness) due to a context dependent nature of the study.

Furthermore, mobile phone adoption may influence timely and accurate marketing information which intend improve marketing decision, increase productivity, sales and hence increase income of smallholder farmers as depicted in figure 2. Non adopters are likely to face limited marketing information which in turn hinder marketing decision, decrease productivity, reduce sales and hence decrease income (figure 2). However, the extent to which adopters use mobile phone for marketing and the challenges they face in using mobile phone for marketing may also hinder their marketing information flow of which the research further sort to identify them.

Food crops such as maize, cassava and plantain were the particular focus for the study area. Out of 120,626 of the farming household 69,678 households are engaged in crop farming (G.S.S, 2020). The framework contributes to help discern the prospects of enhancing the adoption of mobile phone-based information sources

by individual farmers and may also envisage other related welfare outcomes among smallholder farmers as illustrated in conceptual framework below

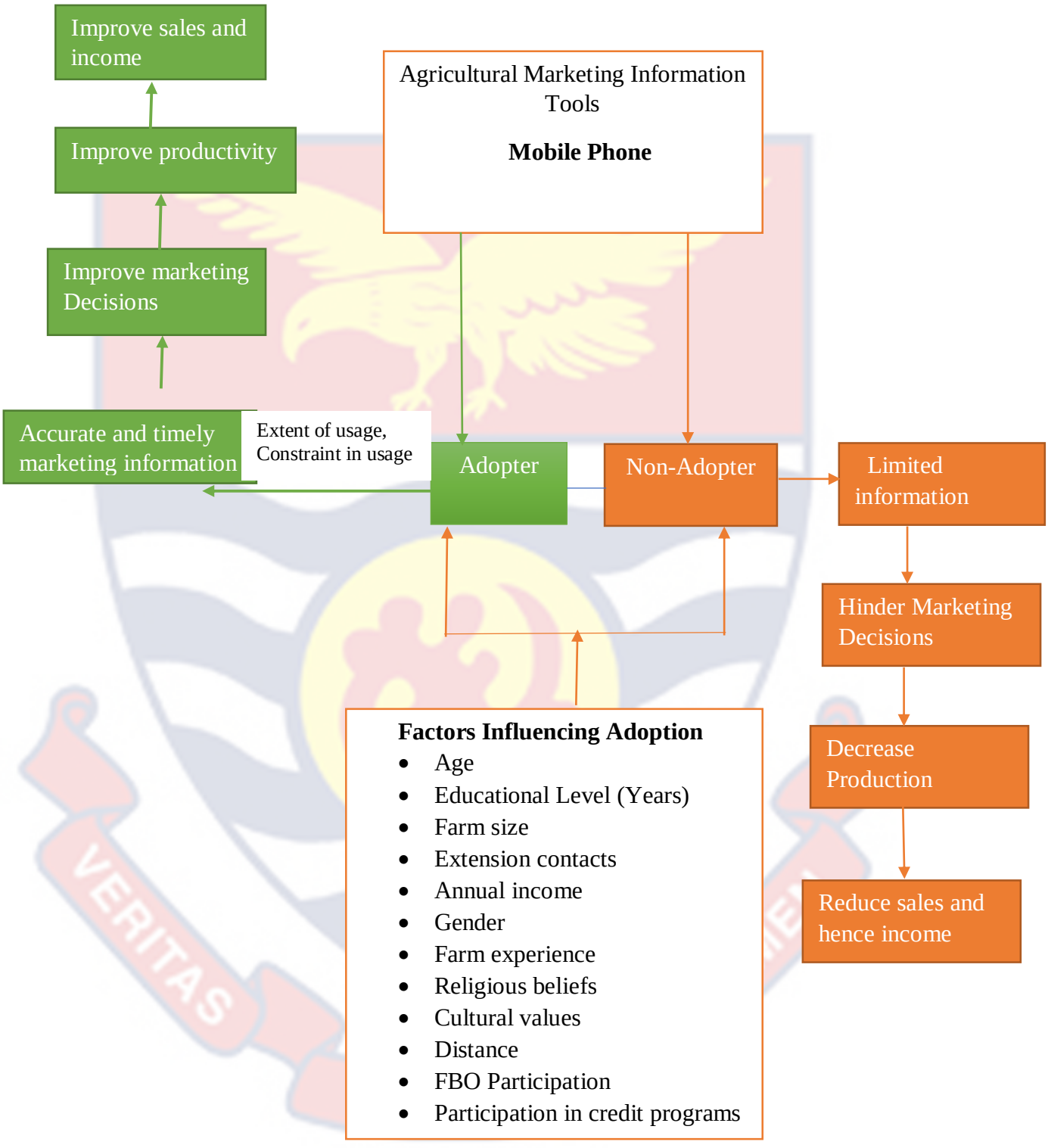

Figure 2: Conceptual Framework

Source: Authors construct (2021)

Chapter Overview

This section addressed important information on topics like background to e agriculture, information dissemination, information needs of farmers as well as theories like theory of reasoned action, Theory of planned behaviour and technology acceptance model guided the study. Also, review of literature on some modes of estimation like the Kendall's coefficient of concordance was captured.

CHAPTER THREE

RESEARCH METHODS

The research methodologies utilised to carry out the study are presented in this chapter and are arranged as follows: research design, study area, population, sampling technique, data collection tools, data collection procedures, and data processing and analysis.

Research Design

In this study, a descriptive cross-sectional survey approach was employed. In this survey approach, respondents are interviewed and data is collected from a sample to be representative of the population. In this study, the design is crucial because it enables the collection of comparable data from farmers in various communities within the same district at a particular time or point in time. Additionally, all variable data will only be gathered once. This survey's design makes it relatively quick and simple to carry out (no long periods of follow-up). The study followed the positivism research philosophy and it employed the quantitative research approach.

Description of the Study Area

In Ghana's Central Region, in the Assin North district, the study was carried out. According to a publication from GSS (2014), Assin North Municipal Assembly (A.N.M.A.) is one of the twenty (20) MMDAs in Ghana's Central Region that Assin South District Assembly was formed out of in August 2004. Assin North Municipal is located between the longitudes of 1 º 05' East and 1 º 25' West and the latitudes of 6 º 05' North and 6 º 04' South in the northernmost part of the Central Region. Assin North

Municipal is situated in the Northern corner of the Central Region within Longitudes 1º 05’ East and 1º 25’ West and latitudes 6º 05’ North and 6º04’ South.

The Municipality shares common borders with Birim North (in the Eastern Region) on the East, Adansi East (in the Ashanti Region) on the North, Upper Denkyira (in the Ashanti Region) on the North-West, Twifo Heman Lower Denkyira (in the Ashanti Region) on the West, Assin South District Assembly (in the Ashanti Region) on the South, Asikuma Odoben-Brakwa (in the South-East. The Municipality, which includes Assin Fosu, the Municipal Capital, has a total land area of around 1,188 square kilometres.

According to the 2020 Population and Housing Census, there are 120,626 people living there, with 51% of women and 49% of men. Eighty percent of people aged 11 and over are literate, whereas only twenty percent are not. Male literacy rates are higher (53.2%) than female literacy rates (46.8.2%). English and a Ghanaian language were both read and written by about six out of ten respondents (60.7%). In the municipality, 47.1% of people aged 3 and older (64,528) are currently enrolled in school.

The municipality's primary economic activities include farming, trading, mostly in wholesale and retail markets, agro-processing, and services. 76.5 percent of the population is economically inactive. 97.8% of those who are economically active are employed, while 2.2% are jobless. A greater proportion of individuals who are economically inactive are students (54.3%), domestic chores are done by 22.9% of them, and disabilities or illness prevent them from working for 7% of them. For the

first time, 67.8% of the unemployed are looking for work, or six out of ten (GSS, 2020).

About 63.2% of the working population in the Municipality is employed by agriculture and allied activities, which are the region's most important economic drivers. Commerce 24.8%, Services 9.6% and Industry sector 2.4%. Most of the farming activities in the region are performed by small-holder farmers, who cultivate crops such as cassava, maize, plantain, cocoa, palm tree, garden eggs, rice etc., (GSS, 2020).

In the municipality, up to 74.4 percent of households are involved in agriculture (GSS, 2020). The percentage of people working in agriculture in rural areas reached as high as 86.3 percent, compared to 14.7 percent in urban areas. 78.5 percent of households in the municipality are engaged in crop cultivation. With a share of 60.6 percent, poultry (chicken) is the most common animal raised in the municipality.

78.1 percent of those aged 12 and over own or use a cell phone. In comparison to women, who own mobile phones at a rate of 31.7%, men own mobile phones at a rate of 46.9%. (GSS, 2020). Only 2512 houses, or 2.4 percent of all households in the municipality, have access to internet facilities for people aged 12 and older, whereas 3.6 percent of households have desktop or laptop computers (GSS, 2020). Additionally, only 2.4% of residents in the municipality utilize the internet. Male users (3.4%) use the internet facility in the district more frequently than female users (1.4%). Lack of internet access in the municipality or ignorance of how to utilize it could be the cause of the low utilisation of the facility.

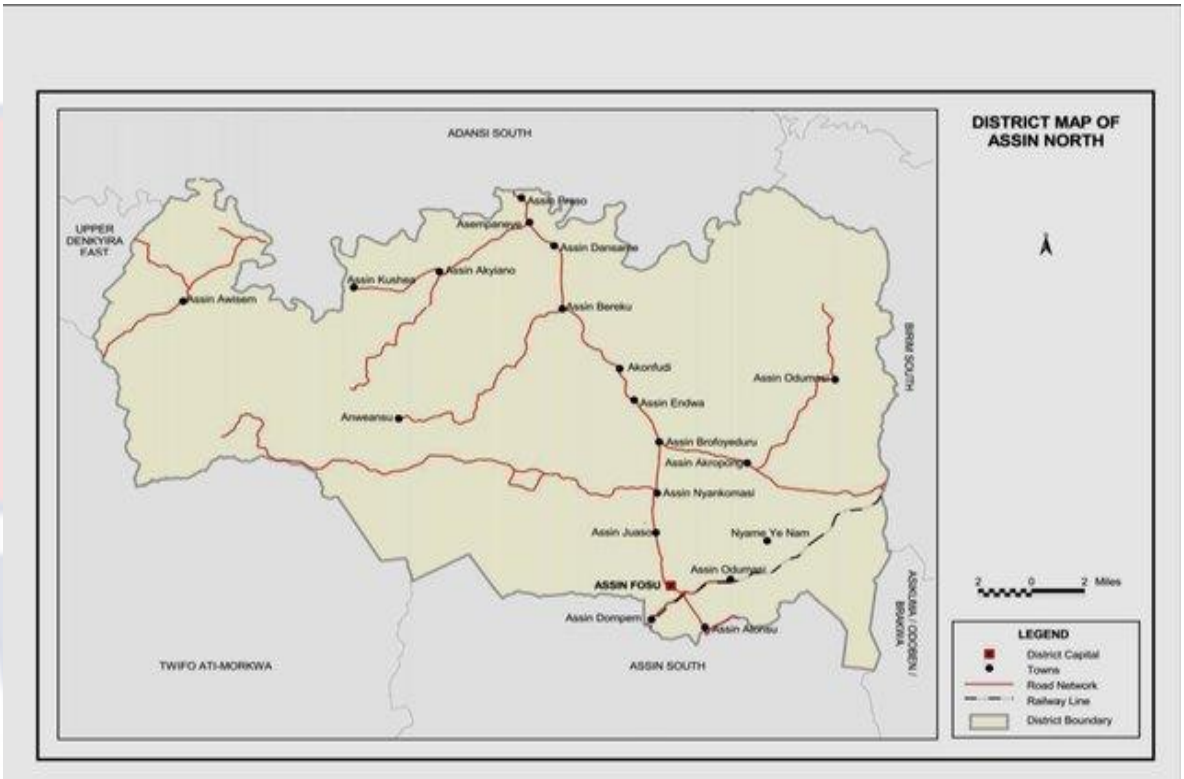

Figure 3: **Map of Assin North District of Ghana**

Source: Ghana Statistical Service (2020)

Source of Data

Both primary and secondary data were used in the study, however primary data predominated. A well-structured and planned pre-tested questions containing both open-ended and close-ended questions was used to collect the primary data from the field survey. It asked questions about the respondents' socio demographic make-up, the extent to which smallholder farmers used mobile phones for marketing information in the study area, the influences of smallholder farmers' decision to use mobile phones for marketing, how smallholder farmers obtain information for marketing food crops, and the barriers to using mobile phones to access marketing information. Extension

offices in the district provided information on the number of smallholder food crop producers in the communities, which was used in the study as a source of secondary data.

Population

All smallholder food crop producers in the Assin North district is the study's target group. There are 120,626 households' population in the Assin North district, and 69,678 of the farmers there grow food crops (GSS, 2020). The target population (69,678) consists of individuals from a range of ages, genders, and educational and cultural backgrounds.

Sampling Procedure

The Assin North District's 69,678 smallholder food crop producers were the target population. However, due to the difficulties the researcher encountered in gaining access to the entire population, it was challenging to obtain information from all farm houses in the Assin North Municipal. This challenge can be attributed to the size of the population, time constraints and the cost involved in reaching out to each respondent.

Saunders, Lewis, and Thornhill (2017) propose the creation of a sample from the population as a solution to this problem. As a result, Yamane's statistical sample size calculation was used to determine the sample size. A simplified formula from Yamane (1967) was utilized to determine the right sample size for this study. The equation proving this is given below:

$$n = \frac{N}{1+N(e)^2} \quad (1)$$

The above expression has the following components: n = sample size, N = population size, e = accuracy level (error margin: corresponds to 95% confidence level), and 1 = constant term. Therefore, 69,678 food crop farmers are anticipated to be in the farming population (GSS, 2020), accounting for 78.5% of all farmers. Thus, the sample size for the research area was determined using the following formula;

$$n = \frac{N}{1 + N(e)^2} \quad (1.1)$$

$$n = \frac{69,678}{1+69,678(0.05)^2} = 400 \quad (1.2)$$

The study employed the multi-stage sampling technique. Assin North District was purposefully chosen in the first stage due to the district's high concentration of smallholder food crop farmers and the fact that studies like Baffoe-Asare, Danquah, & Annor-Frempong, (2013) have demonstrated that the insufficient marketing information resulted in underproduction, which negatively impacted the farmers' welfare and income levels. Therefore, there is the need to enhance the adoption of mobile phone for accurate and timely information.

Secondly, due to the inability to collect data from all smallholder food crop farming communities in Assin North District, six farming communities (Assin Akonfudi, Assin Bereku, Assin Atonsu, Assin Brofoyeduru, Assin Dompe, Nyame ye nam) were randomly selected from the predominantly food crop smallholder farming communities in the Assin North district. Specifically, the lottery method was used to arrive at the six farming communities.

Thirdly, a list of smallholder food crop producers was drawn at random from the six villages with the assistance of village leaders and extension agents. Three hundred and ninety-four of the four hundred farmers interviewed produced full responses. The 394 constitute more than 95% of the projected sample size, and as a result, they can serve as a good representation of the Assin North District's smallholder food crop producers.

Table 2: **Tabular illustration of the sampling procedure**

Dominant food crop communities	Sample
Assin Bompe	64
Assin Brofoyeduru	69
Assin Kushea	65
Nyame ye nam	68
Assin Akonfodi	69
Assin Bereku	65
Total	**400**

Data Collection Instruments

Based on the study's goals and literature review, a structured interview was created as the data gathering tool because it aids the researcher in reducing survey dropout rates and enhancing the quality of data gathered, leading to more impartial study findings. To gather data from the respondents, a well-constructed questions for interview was created and pre-tested. The responders were asked both closed-ended and open-ended questions. In contrast to closed-ended questions, which only offered a limited range of options, open-ended questions allowed respondents to voice their opinions on several significant study-related issues whiles answering questions which demands why, how, when etc.

The questions were in five sections, which is A, B, C, D and E. Section A consisted of questions on smallholder farmers' socio economic, demographic and cultural characteristic such as age, sex, farming income, religious affiliation, ethnic affiliation, conversant language etc.

This was followed up by section B which elicited information on tools, sources and formats of information dissemination. Information tools such as radio, mobile phone, television and information sources such as, extensionist, town criers, NGOs, farmer union, other farmer, Farmer Base Organization were the studied. Also, information format such as print, voice, video-audio visual, video, SMS were measured with respect to the format in receiving agricultural information.

Moreover, questions such as mobile phone ownership, types, and its usefulness coupled with the extent of use for marketing were asked in relation to extent of use for section C.

Section D contained information on the influencing factors of adoption/non adoption of mobile phone for marketing. Hence information was obtained on institutional factors, situational factors, cultural factors, demographic factors and socio-economic factors.

Section E was used to obtain information on the constraint to the use of mobile phone for accessing information for marketing. Variables such as poor-quality battery of mobile phones, cumbersome internet use, and lack of knowledge using mobile phones, mobile phone network problems and high cost of using mobile phones were the variables measured.

Validity and Reliability

Pre-testing the questions was done to make sure it was valid and reliable, to make sure the questions were simple enough for anyone to understand and respond, and to make sure the time it took to do so was reasonable. Two weeks before the structured interview was actually performed, a trial data collection effort employing the questions was made. In order to ensure face and content validity, ten smallholder

crop farmers from each of the three agricultural farming communities (Jukwa, Efutu, and Ayensudu) that were excluded from the actual study were chosen.

The internal consistency of the instrument was tested using the Coefficients alpha (Cronbach's alpha), which is a measure of instrument dependability. With regard to how many items on a scale are evaluating the same content, this estimate of item redundancy was given (Cohen & Swerdlik, 2015). The Cronbach alpha coefficient value of 0.86 was greater than 0.70, which allowed for acceptance of the instruments' reliability.

Data Collection Procedure

The structured interview was used to collect data from smallholder food crop farmers. Whiles some of the interview was done on their way to the farm, some was done on their farms and others in their homes, in order to meet the study's objectives. Four well-trained enumerators and one extension agent and village heads from each of the farming communities in the district were employed to assist the researcher in gathering data using the structured interview form.

The top page of the surveys included a cover letter outlining the guarantees of anonymity, the goal of the study, confidentiality, and the fact that participation is voluntary because the study is only being done for academic purposes. The study's data collection process took a month. The incident took place in September 2021.

Ethical Consideration

Protection of participants and their responses was ensured by obtaining informed consent, protecting privacy and ensuring confidentiality. In doing this, the description of the study, the purpose and the possible benefits were mentioned to participants. The researcher permitted participants to freely withdraw or leave at any time if they deemed it fit. A statement of consent was given to participants to sign as evidence of their willingness to participate in the study. As a way of preventing plagiarism, all ideas, writings, drawings and other documents or intellectual property of other authors were referenced indicating the authors, title of publications, year and publishers. In the case of an unpublished document, permission was sought from the owners.

Data Processing and Analysis

R statistical software package version 4.0.0 and IBM Statistical Package for Social Sciences (SPSS) software version 25.0 were used to process the data. The research questions guided the study of the data. The data were analyzed using descriptive statistics, Kendell's coefficient of concordance, and binary logistic regression model. The open-ended replies from the "other (specify)" options on the surveys and the secondary data from the literature review were both subjected to content analysis.

In order to comprehend and derive meaning from the acquired data, it was necessary to conduct an analysis. The researcher can draw findings and make recommendations by using the data analysis to help understand research problem, the relationships between research variables, and the answers to research-related

questions and problems. In objective one, tools used by smallholder farmers to access agricultural marketing information, was also analysed using descriptive statistics such as frequencies and percentages. In objective two, a binary logistic regression model was used to identify factors (treatment variable) that influence the adoption of mobile phone for marketing (response variable). The response variable is a dummy variable which takes a value of 1 for mobile phone adopters and 0 for non-adopters. The mean difference of output and sales of adopters and non-adopters of mobile phone for marketing information was analysed with the help of independent sample t test since the population standard error was unknown.

With respect to objective three, the extent of mobile phone use for marketing was analysed with the help of a five-point Likert scale. Objective four consist of the constraint to the use of mobile phone for marketing information and a non-parametric statistical analytical tool such as the Kendall's Coefficient of Concordance was used to rank a given set of constraints such as poor-quality battery of mobile phone, internet use been difficult, limited knowledge using mobile phones and mobile phone network problems from the most limiting to the least limiting constraints.

Theoretical Model Specification

Estimation Technique for Determinants of Adoption of Mobile Phone for Marketing Information.

The variables influencing smallholder food crop farms to adopt mobile phone for marketing was identified using a binomial logistic regression model. This allows you to investigate the impact of a large number of independent variables$x_1 \ldots . x_k$, on the dependent variable Y, which is a dichotomous variable with two possible values:

1 or 0. The value of the variable Y = 1 denotes the occurrence of the specified event. Otherwise, the value of this variable is 0. The regression analysis technique helps you to figure out which elements are the most essential for the occurrence of a specific event, which ones can be ignored, and how they interact (Larkai, 2019). The logistic regression model is modeled based on a response variable that has a binomial distribution (Acquah, 2018). Its values are in the range (0 and 1). Following (Larkai, 2019), the logistic regression is given as;

$$f(z) = \frac{e^z}{1+e^z} = \frac{1}{1+e^{-z}}, z \in R \quad (3)$$

As a result, the logistic regression model applies to two-categorical dependent variables with just two possible values: 0 and 1. The conditional probability that the dependent variable Y would adopt the value 1 for the independent variables $x_1, x_2 \ldots, x_k$ has been substituted with the anticipated value of the dependent variable. The conditional probability of this variable assuming the distinguished value is determined by the logistic regression model for the dichotomous variable Y, which is stated by the following relationship

$$P(y_i = 1|X_1 \ldots \ldots X_k) = \frac{e^{(a_0+a_1X_1+\cdots+a_kX_k)}}{1+e^{(a_0+a_1X_1+\cdots+a_kX_k)}} \quad (4)$$

Where a_0, a_1,...a_k are model parameters, and x_1 ,..... x_k are independent variables that might be qualitative or quantitative. The regression coefficients in a logistic regression model do not reflect a measure of the relationship between the variables because of the model's non-linearity with regard to independent variables and

parameters. The notion of the Odds Ratio is presented for this reason. The notion of chance is defined as the ratio of the likelihood of a particular occurrence occurring vs the probability of it not occurring (Larkai, 2019), this is given as

$$\frac{P(y_i = 1|X_1 \dots \dots X_k)}{1 - P(y_i = 1|X_1 \dots \dots X_k)} \quad \frac{\frac{e^{(a_0+a_1X_1+\cdots+a_kX_k)}}{1+ e^{(a_0+a_1X_1+\cdots+a_kX_k)}}}{\frac{1}{1+ e^{(a_0+a_1X_1+\cdots+a_kX_k)}}} \tag{5}$$

$$= e^{(a_0+a_1X_1+\cdots+a_kX_k)} \tag{5.1}$$

The odds ratio is a measure of how closely exposure and outcome are linked. It gives an estimate of the connection between two binary variables ("yes" or "no"), along with a confidence interval. Because the natural logarithm of the odds ratio is linear in proportion to independent variables and model parameters, estimation is much simplified. The natural logarithm of the odds ratio, according to Anning et al. (2012), is as follows:

$$\text{Logit } P = ln \frac{P(y_i = 1|X_1 \dots \dots X_k)}{1- P(y_i = 1|X_1 \dots \dots X_k)} = a_0 + \sum_{i=1}^{k} a_i X_i \tag{6}$$

The share (fraction) of "ones" in the sample is used to determine the boundary value a. After that, the estimated model's accuracy may be evaluated by counting properly and incorrectly categorized examples.

Empirical Model Specification

Following the theoretical literature reviewed above, particularly, (Larkai, 2019; Kujawska, Strzelecka & Zawadzka, 2021) the study in an attempt to achieve objective three will use the binomial logit model. The explained variable is the

farmer's decision on mobile phone use; whether to adopt mobile phone for marketing information or not to adopt for marketing information. Explanatory variables are age, education, sex, farm size, annual income, distance from farmers home to local market, distance from farmers home to electricity base, religion, cultural values, participation in Farmer Base Organization and credit accessibility.

$$Mobile\ phone\ Adoption = \beta_0 + \beta_1 income_i + \beta_2 farm\ size_i + \beta_3 Edu_i + \beta_4 gender_i + \beta_5 age_i + \beta_6\ Extension\ contact_i + \beta_7 member\ FBO._i + \beta_8 Credit\ access_i + \beta_9\ religion_i + \beta_{10} cultural_i + \beta_{11} Distance\ to\ market + \beta_{12} Distance\ to\ electricity\ base_{i_i} + \beta_{13} Farm\ Experience_{i+}\varepsilon_i \quad (7)$$

A description of the explained and the various explanatory variables for the binomial logit regression model and their respective a- priori expectation is given in table 3.

Table 3: Explanatory variables for the Binomial Logit Model

Variables	Description	Measurement	A-priori Expectation
Mobile phone Adoption	The decision to adopt or not	Adopter=1 Non Adopter=0	
Gender	The gender of the farmer	Male=1, Female=0	±
Age	Age of the farmer	Years	–
FBO Participation	Participate in farmer-based organization activities	Yes=1, Otherwise =0	±
Access to Credit	Credit accessibility	Yes =1, Otherwise = 0	±
Income	Annual income	Ghana Cedis	+
Religion	Religious influence	Yes =1, Otherwise = 0	±
Cultural Values	Influence by cultural values	Yes =1, Otherwise = 0	±
Extension Contact	Access to Extension Service	Number of times Yes =1, Otherwise = 0	+
Distance	Distance from farmers home to local market	Yes =1, Otherwise = 0	±
Distance	Distance from farmers home to electricity base		±
Education	Years of education	Years	+
Farm experience	Number of years in farming	Years	-
Farm Size	Size of the land available	Acres	+

Source: Field survey, (2021)

Hypothesis Testing of the Regression Analysis

The hypothesis of the regression analysis is presented below. The decision rule of the hypothesis is also given as;

$Ho: \beta i = 0$

$H_A: \beta_i \neq 0$

Null hypothesis (H_o): The adoption of mobile phones for marketing is not significantly impacted by the explanatory variables taken individually.

Alternative hypothesis (H_A): The adoption of mobile phones for marketing is significantly influenced by the explanatory variables on an individual basis.

The alternate hypothesis is rejected if the p-value exceeds the critical value at 1%, 5%, or 10%. If not, we don't rule out the alternate hypothesis.

Empirical Model Specification

With regards to research objective two, following previous studies particularly (Dadzie & Acquah, 2012; Jae Hung, 2020) presented a modified construct to the study of the extent to which smallholder farmers adopt mobile phone for marketing. Using a 5-point Likert scale, rating as very often = 5, often = 4, sometimes = 3, rarely = 2, never = 1. Where "very often" means mobile is used to access information which helps with respect to deciding what to produce, harvest, assemble, grade, package, storage, transportation and distribution. However, according to (Nkuba, 2016), smallholder farmers may not be involved in all the stages in agricultural marketing due to the operation of middlemen. However, information needs are paramount for farmers in

every stage in agricultural marketing for effective decision making; "Often" means mobile phone is used to access information on harvesting, grading, storage; "Sometimes" means mobile phone is used to access information occasionally during production. Information on weather condition, planting methods, fertiliser application is occasionally accessed. "Rarely" means mobile phone is used to access information occasionally when harvesting season approaches. "Never" means mobile phone does not contribute to information access.

Theoretical Model Specification

Kendall's Coefficient of Concordance

To determine which constraint is the most limiting constraint for the farmer, the Kendall's coefficient of concordance was utilized to rank the different constraints. A non-parametric statistical technique known as the Kendall's Coefficient of Concordance is used to rank a collection of restrictions from the most limiting to the least restricting and to gauge the level of agreement among the respondents.

Using the Kendall's coefficient of concordance, a list of restrictions validated by farmers was examined and rated in order of importance. These included a lack of knowledge/skills to operate mobile phone applications, a terrible (erratic) network, a poor-quality battery, complicated internet use, and a high cost of using a mobile phone. The Kendall's coefficient is defined as follows (Legendre 2005):

$$W = \frac{12S}{P^2 (n^3 - n) - pT}$$

• n= Number of ranked constraints

• S= deviation squared total

• T= tied correction factor

• p= the number of judges

W = 1 represents perfect agreement, W = 0 represents no agreement, and W = 3 represents intermediate values of 'W' show a higher or lower degree of agreement among the various responses.

The following hypothesis and significant test for w (F-Test) are also performed:

H_0: There is no agreement among the rankings of the constraints by the farmers.

H_a: There is an agreement among the rankings of the constraints by the farmers.

Where; H_0 and H_a denote null and alternate hypothesis respectively.

For the decision rule, if the calculated F-value is greater than the tabulated F-value, we reject the null hypothesis that there is no agreement between the rankings of the constraints, meaning that the respondents (farmers) agree on the ranking of the constraints.

Empirical Specification

The various constraints were ranked using Kendall's coefficient of concordance to identify which is the most restrictive to the farmer. There are, however, ranking approaches such as the Garret ranking method, the Freedman ranking method, and the Spearman ranking method. The Kendall's coefficient of concordance, on the other hand, was chosen because of its low asymptotic variance, which makes it efficient, and its low gross error sensitivity, which makes it more resilient. The fifth objective adapted the Kendall Coefficient of Concordance. Specifically,

$W = \frac{12S}{P^2 (n^3 - n) - pT}$ where W= Kendall's coefficient Concordance, T= Sum of constraint smallholder food crop farmers face being ranked, P= Total number of

respondent (smallholder food crop farmers) and n= Total number of constraints in the use of mobile phone for marketing being ranked. The constraint was ranked as Most limiting difficulty to least limiting difficulty using numerals with 1 being most limiting difficulty and 5 been the least limiting difficulty in using mobile phone for marketing information. The decision rule is that we reject the null hypothesis such that there is no agreement between the rankings of the constraint in using mobile phone for marketing food crops, if the calculated F-value is greater than the tabulated F-value, implying that the respondents (smallholder food crop farmers') agree with each other on the rankings.

Chapter Summary

The methodological issues that were investigated and applied in the research were the chapter's main topic. The research design, research methodology, and positivist research philosophy that guided the study were all covered in the chapter. The study location, or Assin North District, as well as the methods employed to create mixed research instruments were also described. The sampling process and sample size were also covered in this section. The study also covered the smallholder food crop producers that made up the study's target group. The study used a structured interview guide to collect data, R Statistical software and SPSS version 25.0 was used to analyze the data.

CHAPTER FOUR

RESULTS AND DISCUSSION

Introduction

This chapter presents and analyses the study's findings. There are eight sections to the analyses. These include descriptive statistics of the socio-economic characteristics followed by tools used in accessing marketing information, determinants of adoption for marketing information, price, output and benefit variations of adopters and non-adopters of mobile phone for marketing information, extent of use of mobile phone for marketing information and constraint in usage of mobile phone for marketing information.

Descriptive Statistics

Socio-Economic/Background Characteristics of Respondents

Table 4 shows the distribution of the sampled farmers based on gender, age, education, marital status, involvement with farmer-based organisations, years of farming experience, size of farm, and contacts with extension agents as well as mobile phone type, access to mobile phone, mobile phone ownership and access to internet, network subscription of the respondents.

Of the sampled farmers, there were more males than females. While women made up 37.6%, men made up 62.4%. This demonstrates that the cultivation of food crops in the research area is largely dominated by men. Assin North may culturally be in a position to favour males over females in terms of land acquisition and production inputs. This is consistent with studies like Larkai (2019), which found that men typically dominate small-scale farming while women are primarily involved in harvesting.

Over 40 years old make up 73.8% of the responders. This suggests that there is limited youth involvement in food crop farming, likely as a result of the fact that the majority of youth are in school and also participate in non-agricultural activities. This is in line with the findings of Sumberg, Yeboah, Flynn, and Anyidoho (2017) who investigated the attitudes of young people on farming in Ghana and discovered that young people believe there are alternative options, such as off-farm activities and also rural areas are not attractive.

Also, in terms of educational attainment, about 23.1% of the population lacked any sort of formal education. 56.1% of farmers had completed primary school, while 10.7% had completed Junior High School and 7.9 % had also completed secondary school. Only 2.2% percent of farmers have earned a degree beyond secondary school (tertiary). This shows that low percentage (23.1%) of farmers had no formal education. Out of the 23.1% who had no formal education, 18.2% had no educational background and 4.9% had informal education. The study report that majority of smallholder farmers have lower level (primary) of formal educational (56.1%). High levels of education, according to Dountio et al., (2016), make people more receptive to change and innovation. In reference to this, it is anticipated that majority of smallholder food crop farmers at the study area will be non-adopters of mobile phone for marketing since majority have primary level of education.

There were just 15.2 percent single farmers compared to 81.2 percent married ones. Farmers had a divorce or separation rate of 2.8% and a widow/widower rate of 0.8%. Only 28.4 percent of farmers were FBO members, while the other 71.6 percent opted not to join and participate. The reason for the low participation of Farmer Base

Organization activities may be associated to low incentive provided by the Organization. This is supported by Okello, (2010) who found out that smallholder food crop farmers are more likely to join Farmer-Based Organization influenced by lucrative incentives and benefit. Only about 49.2 percent of farmers reported interacting with extension officers, while 50.8% said they had no such interactions.

The percentage of farmers who had access to mobile phone was 98% and those who did not have access to mobile phone were 2%. This indicates that there is a high mobile phone ownership as reported by (GSMA, 2020). Moreover, the percentage of farmers who own mobile phone was 93% whiles those who did not own mobile phone were 7%. This supports the findings that 78.6% of population 12 years and above own or use mobile phone juxtaposing a high mobile phone penetration rate, (GSMA, 2020). 69% of the farmers use smart phones whiles 31% did not use smart phones. 54.3% subscribe to MTN. 25.9% subscribe to Vodafone. 17.0% subscribe to Airteltigo and 2.8% subscribe to Glo Network. After the survey of farmers in Assin North, it was discovered that their average farm was 4.2 acres in size. Farmers had, on average, 14.8 years' worth of experience. 64% of mobile phone users had access to internet.

Table 4: Socio-Economic/Background Characteristics of Respondents

Variable	Category	Frequency	Percentage
Sex	Male	246	62.4
	Female	148	37.6
Age (years)	20-40	103	26.2
	41-60	213	54.1
	Above 60	78	19.7
Educational Level			
	None	91	23.1
	Primary	221	56.1
	JHS	42	10.7
	Secondary	31	7.9
	Tertiary	9	2.2
Marital Status			
	Married	320	81.2
	Single	60	15.2
	Divorced/Separated	11	2.8
	Widowed	3	0.8
Mobile Phone Type			
	Smartphone	272	69.0
	Non-smart	122	31.0
Access to Internet			
	Yes	252	64.0
	No	142	36.0
Mobile Phone Ownership	Yes	366	93.0
	No	28	7.0
Access to Mobile Phone	Yes	386	98.0
	No	8	2.0
Network Subscription	MTN	214	54.3
	Vodafone	102	25.9
	AirtelTigo	67	17.0
	Glo	11	2.8
FBO Participants			
	Yes	112	28.4
	No	282	71.6
Farm Size (acres)			
	Less than 5	240	60.9
	5-10	143	36.3
	11-15	7	1.8
Farm Experience (years)	Above 15	4	1.0
	Below 10	54	13.8
	10-20	170	43.1
	21-30	60	15.2
	Above 30	110	27.9
Extension Contact			
	Yes	349	49.2
	No	200	50.8

Source: Field survey, (2021)

Summary Statistics on the Socio-Economic Characteristics

Based on the average age of the respondents in Table 5, it is clear that there is a lack of young participation in food crop cultivation. Reasons for this may include the fact that most young people are occupied with things outside of farming, such as attending school. This is supported by a report from (PHC, 2020) stating that most youth between the ages of 15-25 are mainly enrolled into the formal education system. With an average of 4.4 people per home, the study area has a slightly larger family composition than the national average of 4.0 (PHC, 2020). This suggests that the farmers will be able to save money on labour thanks to their big family size. This lends credence to the findings of Deichmann et al., (2016), who found that high family sizes boost family labour, which decreases labour cost in agricultural production.

Farmer land holdings averaged 4.2 acres (less than 2 hectares). The report from Ghana's Ministry of Food and Agriculture concurs with this, stating that the vast majority of the country's land is farmed by smallholders (of which 90% have plot sizes of less than 2 hectares) (MoFA, 2014). In contrast, Larkai (2019) found that smallholder farmers typically farmed on plots of land larger than 2 hectares.

Table 5: Summary statistics on the Socio-Economic Characteristics

Variable	Minimum	Maximum	Mean	Std. Deviation
Age	31	72	46.8	20.3
Household Size	2	11	4.4	1.8
Experience	14	44	14.8	9.6
Size of land Owned	2	13	4.2	3.7

Source: Field survey, (2021)

Identification and Description of the IMITs Used by Smallholder Farmers to Access Information for Marketing Food Crops

The research catalogued the various AMITs that farmers typically employ. They are television, radio, mobile phone and face to face verbal communication. Table 6, shows the various tools used by smallholder food crop farmers, the number of farmers using that tool(s) and their percentage. It was noticed that some farmers were employing multiple tools. 19.5% of farmers exclusively utilized only mobile phone, 4.6% exclusively used radio, and 3.6% exclusively used television to access marketing information. This is consistent with the notion of Chhachhar et al., (2012), that farmers rely minimally on television for market updates as farmers were influenced through extension contact. They continued by saying that because agricultural shows are not broadcast at the appropriate times, the majority of farmers are not motivated to look for agricultural information on television. As a result of this phenomenon, mobile services are now employed in agriculture to share and obtain information.

3.1% of farmers used their mobile phone and radio to acquire information, compared to 2.5% who used their phone and television. About 2.0 percent of farmers utilize radio and television, while on 26.1% use their mobile phone, TV, and radio to acquire information about agricultural marketing. Table 6 displays the frequency and percentage of use of the different AMITs by farmers. Mobile phone, radio, and television are the most popular devices used together, followed by radio solely and mobile phones. However, 15.5% of farmers assert that they get face-to-face (FTF) access to agricultural marketing information from other farmers and extension officers.

Conclusively, other farmers and extension officers via face-to-face interactions, mobile phone, radio and television are the main tools used to access marketing information by smallholder food crop farmers (Table 6). The findings of this study show that smallholder food crop producers attempt to apply a number of potentially complimentary methods. This implies that no one informational technology may satisfy all of the information requirements of smallholder food crop farmers. It is consistent with the findings that to gather data for their sales efforts, small farmers used a wide range of resources (Alavion et al., 2017; Mittal & Mehar, 2016).

The conclusions of Hung Jae (2020), who claimed that smallholder farmers use mobile phones the most to get marketing information, are inconsistent with the findings of this study. About 23.1% of smallholder farmers use no tool to access marketing information and claim they dwell on personal experience in marketing and also most of the produce are consumed by the household. Therefore, they are not much concentrated on the food crop but rather have a cash crop farm such as cocoa, palm tree for palm oil where most of their resources are channeled to.

Furthermore, the report from this study that 19.5% receive agricultural information via mobile phone only is consistent with the findings of Mabika's (2019) research which revealed that many sources and channels that respondents used to obtain agricultural information included extension staff, friends, other farmers, the radio, the television, the internet, newsletters, and newspapers. However, 43% of the respondents according to Mabika's (2019) said they receive agricultural information via their mobile phones only and stated that they would be more open to receiving updates of the same agricultural information via mobile phones in the future.

Table 6: Identification of Various AMITs used by Farmers

Type of tools used	Frequency	Percent
No tool used	91	23.1
Other Farmers and Extensionist (FTF)	61	15.5
Mobile phone only	77	19.5
Radio only	18	4.6
TV only	14	3.6
Phone and Radio	12	3.1
Phone and TV	10	2.5
Radio and TV	8	2.0
Phone and Radio and TV	103	26.1
Total	394	100

Source: Field survey, (2021).

Factors Influencing Mobile Phone Adoption for Marketing Information by Smallholder Food Crop Farmers

Table 7 provides an estimation of the results of the logistic regression model of mobile phones to access marketing information. Eight of the thirteen independently evaluated independent variables that affected mobile phone adoption for marketing information were determined to be statistically significant. Age, gender, farm size, education, income, membership and participation in FBOs activities, farmers' experience, and extension contact were statistically significant factors for smallholders.

From table 7, the results indicate that age is statistically significant at 5 percent and there is a negative relationship between age and mobile phone adoption with respect to the odds ratio of 0.383. A marginal effect of approximately 0.146 shows

that a year increase in the age of farmers reduces the probability of farmers to adopt mobile phone for marketing information by 0.146 unit (14.6%). This shows that as farmers grow older and closer to retirement, there is a tendency of difficulties in ease of use which leads to a decline in adopting mobile phone for marketing. This is substantiated by studies such as (Das, 2014; Mittal & Mehar, 2016) which suggest that older smallholder food crop farmers have higher tendency of not using mobile phone for marketing, which is corroborated by findings of this research. Furthermore, Okello et al., (2012) found that younger people more easily pick up new technology than older people do, and that younger people also have a more positive attitude toward new technology. Contrary to popular belief, mobile phone use in agriculture is age-related (Okello et al. 2012). Again, Falola and Adewumi (2012) found a negative correlation between the age of the household head and mobile usage. This is surprising because younger farmers are likely to be more familiar with mobile phones, but households with older heads may also be better able to buy them. This is consistent with the findings of the study.

From table 7, farm size is statistically significant at 5 percent and has a positive relationship with mobile phone adoption in relation to an odds ratio of 2.018. From the results, the marginal effect of 0.537 implies that an increase in farm size by an acre will increase the probability that a famer will adopt mobile phone for marketing by approximately 0.537 (53.7%). This finding concurs to studies by Mittal & Mehar, (2016) in which they asserted that the more farmers have access to land, the more they adopt mobile phone for marketing.

From table 7, extension contact is statistically significant at 5 percent and has a positive impact on adoption of mobile phone for marketing information according to the odds ratio of 1.125. The marginal effect of 0.316 shows that a 1% increase in the number of extension contacts farmers get increases the adoption of mobile phone for marketing by 0.316 (31.6%). This however supports the assertion of Olagunju & Salimonu (2010), and found out that small scale farmers adopt mobile phone technology the more and this was influenced by frequent extension contact.

There was a negative correlation between farming experience and mobile phone adoption with respect to an odds ratio of 0.421, and the level of significance was 1%. A 0.810 marginal effect suggests that a year increase in farmers farming experience will lead to a 0.810 (81.0%) reduction in the likelihood that they will utilise mobile phones for marketing information purposes. This result is in agreement with the findings by Mwangi et al. (2013), who asserted that farmers mostly do not use mobile phones as they gain more farming experience.

Mobile phone marketing adoption was shown to be statistically significant at 1% and to be positively correlated with FBO involvement in this study with respect to 1.747 odds ratio. According to the data in table 7, the marginal effect of 0.721 shows that the likelihood of a farmer adopting a mobile phone for marketing as a result of FBO participation activities is roughly 0.721 (72.1%) times higher than the likelihood of a farmer adopting a mobile phone in relation to not participating in FBO activities. Smallholders who are participants and not mere members of FBOs tend to be mobile phone adopters more than those who are not. This could be because members of FBOs often pool their financial and personal resources to help one another out, making them

better able to take advantage of mobile phones for marketing and sharing timely information. Result like this is in line with the claims made by Hung-Jae (2020) that more FBO membership and participation means more smallholder farmers using mobile phones for marketing.

Smallholders' marketing information efforts that incorporate the use of mobile phones are positively correlated with their number of years in formal education at a 10 percent significance level statistically with an odds ratio of 2.613. The marginal effect of 0.115 shows that a smallholder food crop farmer is 0.115 (11.5%) times more likely to use a mobile phone for marketing information as a result of a one-year increase in the number of years in formal education. This study backs up earlier research (Abebe & Mammo Cherinet, 2019; Alavion et al., 2017) that shows smallholders with higher number of years in schooling are more likely to use mobile phones. Also, according to Dountio, Meukam, Tchaptchet, Ango, and Simo, (2016), having a high degree of education makes people feel more open to change and innovation. Furthermore, farmers' ability to navigate their phones and use them to get farming information depends in large part on their literacy level, which influences their use of mobile phones (Okello-Obura, Minishi-Majanja, 2018).

At the 5 percent significant level, there was a positive correlation between gender and the use of mobile phones in marketing at an odds ratio of 3.030. The marginal effect shows that if a farmer is male, there is a 0.127 (12.7%) times greater chance of him adopting a mobile phone for marketing than there is for a farmer who is female. Male smallholders were found to have greater access to mobile phones and a greater potential for using them for marketing purposes than their female

counterparts. In the study's setting, this disparity may have arisen because men were more likely to own land and livestock, which allowed them to generate a surplus that they could then sell through mobile phone. In addition, males have more leeway to go wherever they like in search of agricultural information, and this factored into their decision to embrace mobile phones. This lends credence to the research of Hung-Jae (2020), who discovered that the use of mobile phones in advertising is more common among men than women in Vietnam.

From table 7, farmers' total annual income is statistically significant at 10 percent and has a positive relationship with the adoption of mobile phones for marketing in reference to an odds ratio of 1.381. The marginal effect of 0.361 implies that a 1% increase in the total annual income will increase the probability of mobile phone adoption for marketing information by 0.361 (36.1%). This is consistent with the findings of Das (2014), who asserted that high income farming families in Ghana are embracing new forms of agricultural technology.

Other variables such as religion, cultural values, distance from market to electricity base, distance from farm to local market and access to credit were all statistically insignificant.

In this study, the Hosmer-Lemeshow test was utilised to measure the goodness of fit in relation to this analysis. The Hosmer–Lemeshow test is useful to determine if the poor predictions (lack of fit) are significant, indicating that there are problems with the model. However, if the poor predictions are insignificant, it indicates the model is a good fit. The Hosmer-Lemeshow P value of 0.167 was greater than 0.050, indicating its insignificance, indicating that the Hosmer-Lemeshow test did not demonstrate a

deviation between expected and observed probability that the binomial distribution does not anticipate, hence the model fits the data set.

The Hosmer-Lemeshow goodness of fit test was performed ahead of other goodness of fit tests because the Hosmer-Lemeshow test is the most trustworthy test since the format of the data has no impact on the Hosmer-Lemeshow test. As opposed to other goodness-of-fit tests like the Pearson and Adjusted R^2 test, it is independent of the number of trials per row in the data.

The Percentage Accuracy in Classification was utilized to offer a summary of the accuracy of case classification, which aids in determining the percent of right predictions produced using this model/equation. 71.7% percentage accuracy in classification shows that the model exhibits good sensitivity since among smallholder food crop farmers who will adopt mobile phone for marketing over non adopters were correctly predicted based on the model.

The Variance Inflation Factor calculates how much an independent variable's behavior (variance) is inflated by its interaction and correlation with other independent variables. Variance inflation factors enable a rapid assessment of the contribution of a variable to the standard error in the regression. According to Potters, (2021) VIF equal to 1 means variable are not correlated. VIF between 1 and 5 means variables are moderately correlated. VIF greater than 5 means variables are highly correlated. In this study, a V.I.F of 1.630 indicates that the independent variables are moderately correlated however there is an infinitesimal or no effect on the independent variables' statistical significance.

Table 7: Estimation of Regression Model for Mobile Phone Adoption for Marketing Information

VARIABLES	Odds ratio	Marginals
Age of smallholders	- 0.383**	0.146
Number of years in education	2.613*	0.115
Distance from farm to local markets	1.372	0.025
Distance from home to electricity base	1.284	0.136
Farm size	2.018 **	0.537
Annual income	1.381*	0.361
Gender	3.030**	0.127
Farm experience	-0.421***	0.810
Smallholders' access to credit	1.071	0.131
Religion	-0.278	0.023
Cultural Values	-0.021	0.101
Extension Contact	1.125**	0.316
Smallholders' participation in FBO	1.747***	0.721
Constant	0.429***	0.000

HL Test = 0.167
Pseudo R2 = 0.2401
Log likelihood = - 459.8627 Standard Error = 0.079
V.I.F = 1.630 Number of observations = 394
P.A.C = 71.7%

*10%, **5%, ***1% significance level, 95% Confidence Interval

Source: Field Survey, 2021

Smallholder Farmers Benefit from using Mobile Phone for Marketing Information

The distribution of mobile phone benefits to farmers is seen in Table 8. It was revealed that smallholder food crop farmers who were mobile phone adopters or non-adopters' dwell on marketing information to make marketing decisions. This proves that marketing information is very vital for marketing decisions for smallholder food crop farmers irrespective of been a mobile phone adopter or non-adopter. Farmers who adopted mobile phones did so to get timely and correct agricultural marketing

information, which was very helpful, effective, and relevant in attaining many goals highlighted below. Non-adopters had improper access to information due to timing issues and non-empirical information sources such as farmers rely more on their local knowledge since, they can forecast the onset of any drought or rainy season in many traditional civilizations and places by the shifting pattern of winds (Fitchett & Ebhuoma, 2018).

About 28.9% of farmers bought agricultural inputs on time using their mobile phones. In a more competitive market, 11.9% of farmers sold their produce using a mobile phone. 45.8% of farmers reportedly utilized accurate and timely information accessed through mobile phone to affect production in order to make well-informed decisions about what to produce and how much of it should be produced. About 13.4% of mobile phone adopters used the information to influence the marketplaces they chose to sell their produce. In order to save money on transportation, non-mobile phone adopters typically sell in markets closer to them. Their farm income was negatively harmed by this.

Table 8: Smallholder Farmers Benefit from using Mobile Phone for Marketing Information

Agricultural Marketing Information	Frequency	Percentage (%)
Purchase inputs	58	28.9
Sell produce	24	11.9
Influence Production	93	45.8
Influence market	27	13.4

Source: Field survey, (2021)

Market Output of Adopters and Non adopters of Mobile Phone for marketing Information by Smallholder Food Crop Farmers

Table 9 compares the market output of food crops (maize, plantains, and cassava) among farmers that have adopted mobile phones for marketing information and those that have not. By the year 2020, smallholder farmers who grew food crops and utilised their mobile phones to access market data were more productive per acre than their non-adopting counterparts. At the 5% level of significance, Table 9 shows that the average yield per acre of plantain bunches, maize, and cassava all varied significantly. The production of about 51 bags of maize, 45 bags of cassava, and 112 bunches of plantains per acre by mobile phone adopters for marketing information was disclosed for the year 2020. On the other hand, non-adopters produced about 88 bunches of plantains, 32 bags of maize, and 29 bags of cassava per acre. This outcome is in line with research by Akudugu, Guo, and Dadzie (2012), who looked at how farm households in Ghana were utilizing contemporary agricultural production techniques.

The study claimed that marketing information affected marketing choices and enhanced farm produce output.

Table 9: Market Output of Adopters and Non adopters of Mobile Phone for marketing Information by Smallholder Food Crop Farmers

Agricultural produce	Output per acre bag/bunch (2020)			t-value
	Mobile phone adopters	Non-mobile phone adopters	Mean difference	
Cassava (91kg)	45	29	16	2.335**
Plantain	112	88	24	2.403**
Maize (100kg)	51	32	19	2.802**

Source: Field survey, (2021).

Prices of Market Output of Mobile Phone Adopters and Non-Adopters Smallholder Food Crop Farmers

Table 10 shows the differences in food crop prices between mobile phone adopters to access information and non-adopters. Smallholder farmers of food crops who used mobile phones typically sold their goods for more money than those who did not. The average unit price per bag of cassava and maize is statistically different at a 1% significance level and the average unit price per bunch of plantains is notably dissimilar at the 5% threshold of statistical significance respectively. Access to marketing data could be responsible for this. This study's results suggest that the usage of mobile phones by smallholders for marketing has a favorable effect on the selling price of food products as concluded by Hung-Jae, (2020). The findings of this study partially corroborate those of Tadesse and Bahiigwa (2015), who looked into the

relationship between farmers' marketing choices and the use of mobile phones. They discovered that Ethiopian farmers who use mobile phones sell their rice and maize for higher prices, though this finding was not significant in the statistical sense.

Also, in Turkey, a study on agricultural market data systems was carried out by (Demiryurek et al., 2018). The findings showed that farmers' sales increased when they used mobile phone frequently. More European breeds could be kept, and each cow produced more milk. This is consistent with the findings of this study.

Table 10: Price Variations of Food Crops Output Between Adopters and Non-Adopters of Mobile Phone for Marketing Information

Agricultural produce	Average Unit Price per bag/bunch (September, 2020) in GH₵			t-value
	Mobile phone adopters	Non-mobile phone adopters	Mean difference	
Cassava (91kg)	180.00	120.00	60.00	11.05***
Plantain	45.00	30.00	15.00	2.543**
Maize (100kg)	280.00	200.00	80.00	8.602***

Source: Field survey, (2021)

Relationships Between Smallholders' Characteristics and Mobile Phone Use for Marketing

Based on the data presented in Table 11, it can be observed that the utilization of mobile phones for marketing information among smallholders is statistically linked to their gender and participation in FBOs at a significance level of $p \leq 0.05$. Additionally, Table 12's t-test results indicate a statistical association between the smallholders' use of mobile phones for marketing information and their age, years of schooling, extension contact, farm size, farming experience, and income, also at a significance level of $p \leq 0.05$. These findings indicate that the variation in characteristics among smallholder farmers has an impact on their adoption of mobile phones for marketing information. This research aligns with previous studies (Aldosari, Al Shunaifi, Ullah, Muddassir, & Noor, 2019; Das, 2014; Mittal & Mehar, 2016) that suggest socio-economic factors influence farmers' decision-making in adopting ICT tools for accessing agricultural information.

Table 8: Chi square test for Mobile phone Adoption for marketing Information

Variables		Total (%)	Mobile phone users (%)	Non-mobile phone users (%)	Chi-squares test
Gender	Female	37.6	3.1	32.6	0.012**
	Male	62.4	48.2	18.2	
Access to credit	No	92.2	44.8	47.4	9.58
	Yes	7.8	6.5	1.3	
Religion	No	100.0	51.3	48.7	12.28
	Yes	0.0	0.0	0.0	
Distance from home to electricity base	No	84.2	43.8	40.4	11.89
	Yes	15.8	7.5	8.3	
Distance from farm to local market	No	73.5	41.5	32.0	7.59
	Yes	26.5	9.8	16.7	
Cultural Values	No	91.1	47.4	43.7	6.97
	Yes	8.9	3.9	5.0	
FBO participation	No	71.6	23.6	48.0	0.041**
	Yes	28.4	28.1	0.3	

Table 9: **t-test for Continuous Variables by Mobile Phone Adoption for Marketing Information**

Variables	Mobile phone users		Non-mobile phone users		t-value
	Mean	Std. Dev.	Mean	Std. Dev.	
Age	46.0	18.3	46.8	19.20	5.08***
Extension Contact	3.30	0.98	2.50	0.96	2.223**
Farming Experience	13.98	9.59	13.11	9.15	2.443**
Farm size	4.40	2.21	4.38	1.54	2.317**
Number of years in schooling	23.0	8.62	6.31	1.25	3.006**
Income	4.18	1.36	3.13	1.38	2.028**

Extent of Smallholders' Use of Mobile Phone for Marketing Information

A breakdown of smallholder food crop farmers' mobile phone marketing effort is provided in Table 13. About 7.9% (31) reported using mobile phone to access marketing information as "very often". This means mobile phone is used to access information on what to produce, harvest, assemble, grade, package, storage, transportation and distribution. About 12.2% (48) of smallholder farmers reported marketing via mobile devices as "often". This means mobile phone is used to access information on harvesting, grading and storage. Moreover, about 20.3 % (80) of smallholder food crop farmers reported using mobile phone to access marketing information as "sometimes". This means mobile phone is used to access information occasionally during production. Furthermore, 10.9% (43) of smallholder food crop farmers reported using mobile phone to access marketing information as "rarely". This means mobile phone is used to access information occasionally when harvesting season approaches. Number of smallholder food crop farmers reported not using mobile phones to access marketing information was 48.7% (192).

Based on these findings, although mobile phone is one of the tools of information and communication technology (ICT) utilised by smallholder farmers in the marketing process; however, the extent of use has undermined the benefit of mobile phone as most farmers do not use it “very often and often”. This study's findings are at odds with those of Toluwase and Apata (2017), who found that just 9.2 percent and 44.2 percent of Nigerian farmers use mobile phones to acquire agricultural information "very frequently" and "frequently," respectively.

Table 10: Extent of Smallholders’ use of Mobile Phones for Marketing Information

Extent of mobile phone use	Frequency	Percentage (%)
Never	192	48.7
Rarely	43	10.9
Sometimes	80	20.3
Often	48	12.2
Very often	31	7.9
Total	394	100

Source: Field survey, (2021)

Difficulty in Using Mobile Phone for Marketing Information

Similar to other forms of technology, there are obstacles to using a mobile phone to get marketing information. The greatest and least restricting restrictions on the usage of mobile phones for marketing were determined using the Kendall's coefficient of concordance Thus, the study aimed to uncover some of the barriers that farmers may face while using mobile devices to acquire marketing information, and the findings are shown in Table 14. From table 14, cumbersome in the use of internet, limited knowledge using mobile phone, network problems, poor quality battery and high cost of using mobile phone were listed for smallholder farmers to select constraints encountered using mobile phone for marketing in the study area. With regards to this study, the above constraints were ranked on a scale of one (1) to five (5), with five (5) being the least limiting constraint in using mobile phone for marketing and one (1) being the most limiting constraint in using mobile phone for marketing.

The result from table 14 indicates that the difficulties in the use of internet was the most limiting difficulty in the use of mobile phone for marketing with a mean rank of 1.57. However, high cost of using mobile phone was noted to be the least limiting difficulty with mean rank of 3.62. Kendall's coefficient of concordance was used to determine the level of agreement between the ranks and it shows that there is 41.2% agreement among the farmers that cumbersome in the use of internet was the most limiting difficulty in the use of mobile phone for marketing and high cost of using mobile phone was noted to be the least limiting difficulty. The significance of the limitations was examined using the chi square test, with a 0.05 level of significance. Abebe and Mammo Cherinet (2019) did a study on how Ethiopian farmers use mobile

phones for marketing information. They found that the main problems farmers had were not being able to charge their phones because they didn't have access to electricity and the high cost of buying mobile phones, which is inconsistent with this study.

Moreover, findings in this study is consistent with Darkwaah (2018). According to Darkwaah (2018), the difficulty of using the internet presents the main barrier to using a mobile phone, with roughly 61% and 28% of farmers in the Akwapim south district strongly agreeing and agreeing, respectively, with a mean score of 1.5.

Table 11: **Difficulties to the Use of Mobile Phone in Accessing Marketing Information**

Constraints	Mean Ranking	Rank
Difficulties in the use of internet	1.57	1st
Limited knowledge in mobile phone usage	2.12	2nd
Network problems	2.80	3rd
Poor quality battery	3.14	4th
High cost of using mobile phone	3.62	5th

(Kendall's W[a] = 0.412, Sig. = 0.05; Sample size (n) = 394; Number of ranked constraints=5; df = 4; (1st= Most limiting difficulty, 5th= Least limiting difficulty)

Source: Field survey, 2021

Chapter Summary

The findings of the study were presented and discussed in this chapter. To reflect the chapter's substance, the chapter was introduced. A table indicating socioeconomic and background traits of the food crop farmers in the research region was shown. Results of the identification of AMITs, level of usage, determinants of mobile phone adoption, and adoption barriers were all discussed.

CHAPTER FIVE

SUMMARY, CONCLUSIONS, AND RECOMMENDATIONS

Introduction

The summary of the study's findings is covered in this chapter. The suitable conclusions from both this study's findings and those of other studies are then presented. The next phase provided necessary policy suggestions to decision-makers and future researchers regarding the best course of action for addressing the determinant of mobile phone uptake for marketing food crop.

Summary

This study was conducted with specific objectives; to identify and describe the tools used to market food crops in Assin North District of Ghana, to assess the extent of smallholder use of mobile phone for marketing, to ascertain the factors that influence adoption of mobile phone for marketing and to examine the constraint for using mobile phone for marketing food crops in Assin North District of Ghana.

About 19.5% of food crop farmers (maize, cassava and plantain) adopted only mobile phone for marketing whiles 31.7% adopted mobile phone in addition to other tools such as T.V and Radio for marketing. 51.2% of farmers at the study area adopted mobile phone for marking. Also, 15.5% of smallholder food crop farmers in the study area received marketing information from other farmers and extension officers through face-to-face interactions. 4.6% of farmers used radio only for marketing and 3.6% used only T.V for marketing. 2.0 % of farmers used both T.V and radio. 23.1 % of farmers were non adopters of any Agricultural Marketing Information Tool.

The estimated binary logistic regression model revealed that age, farm size, FBO membership, experience, number of years in formal education, gender, income

and extension contact are significant in explaining the adoption of mobile phone for marketing information. Age influenced farmers' decision to adopt negatively with a significant level of 5%. Number of educational years positively influenced adoption at a 10% alpha level. Farm size positively influenced adoption of mobile phone at 5% significant level. Annual income positively influenced adoption at 10% significant level. Gender influenced farmers' decision of adoption with 5% significant level. Farming experience positively influenced farmers' decision not to adopt mobile phone for marketing information at 1% significance level. Extension contacts positively influenced farmers to adopt mobile phone for marketing information at 5% significant level. FBO positively influenced farmers to adopt mobile phone for marketing at 1% significant level.

Religion, cultural values, distance from farm to local market, distance from home to electricity base, access to credit were statistically insignificant with respect to the adoption of mobile phone for marketing.

About 48.7% of farmers were non adopters of mobile phone for marketing. About 10.9% used mobile phone rarely for marketing whiles 20.3% of farmers sometimes use mobile phone for marketing information. Also, about 12.2% use mobile phone for marketing as often and 7.9% used mobile phone for marketing as very often.

The highest ranked constraint facing the adoption of mobile phone was the difficulty nature of internet use with a mean rank of 1.57 while's least ranked constraint was high cost of using mobile phone with a mean rank of 3.62.

Conclusions

The main objective of this study was to facilitate the adoption of mobile phone for marketing food crops. It was revealed that 98% of farmers have access to mobile phones, 68% are smartphones. This shows that mobile phone is clearly predominant and has penetrated the shores of smallholder food crop farmers in Assin North.

Furthermore**,** radio, T.V, other farmers and extension officers (face to face interaction), mobile phone were the tools used to access marketing information in the study area. The result of this objective reveals that smallholder food crop farmers seek to use several tools which may be complementary whiles others use only one tool. 19.5% use mobile phone alone for agricultural marketing activities. 51.3% of smallholder food crop farmers use at least mobile phone for marketing that enhances their marketing decisions. This reveals that 98% have access to mobile phone and 51.3% use the mobile phone for marketing activities.

Smallholder food crop farmers' adoption of mobile phone for marketing information reduced by 81% with respect to a one-year increase in their farm experience. Essentially, farm experience was a vital influencer with respect to smallholder food crop farmers not adopting mobile phone. However, this insinuates that smallholder food crop farmers' decision not to use mobile phone would depend on the number of experiences in farming. Male smallholder farmers are 12.7% times better mobile phone adopters than female smallholder food crop farmers. A one-year increase in terms of years in schooling increases the possibility of mobile phone adoption for marketing information by 11.5%.

Smallholder food crop farmers who had a high income tends to be a mobile phone adopter compared to those who had a low income. Importantly, smallholder

food crop farmers who are members of FBOs and participate in their activities and have high extension contacts are better mobile phone adopters than those who are not members of FBOs and have low extension contacts.

Moreover, Religion, cultural values, distance from farm to local market, distance from home to electricity base, participation in credit programs were statistically insignificant with respect to the adoption of mobile phone for marketing. It was also concluded that mobile phone adopters had accurate and timely information with influenced their marketing decisions whiles non adopters experienced limited marketing information.

It was revealed that mobile phone adopters produced about 51 bags of maize (100kg), 45 bags of cassava (91 kg) and 112 bunches of plantain per acre in 2020. However, non-adopters produced about 32 bags of maize (100 kg), 29 bags of cassava (91 kg) and 88 bunches of plantain per acre in 2020. It can be deduced that smallholder farmers through the adoption of mobile phone influence their input purchases and improved production.

Also, the results of this study suggest that smallholders' use of mobile phone for marketing has a positive impact on selling price of food crops. In 2020, the average unit price per bag of cassava was sold at GH₵ 180.00 (91 kg) for mobile phone adopters as against GH₵ 120.00 (91 kg) for non-adopters. Moreover, the average unit price per 100 kilograms' bag of maize was sold at GH₵ 280.00 for mobile phone adopters as against GH₵ 200.00 for non-adopters. Furthermore, the average unit price per bunch of plantain was sold at GH₵ 45.00 for mobile phone adopters as against GH₵ 30.00 for non-adopters. Smallholder food crop farmers who adopted mobile

phone for marketing had better sales comparatively as a result of their market intelligence emanating from prompt and accurate information received through mobile phones.

It was revealed that 7.9% of smallholder farmers who were using mobile phones for marketing (51.3%) were using them to assess marketing information on what to produce, harvest, assemble, grade, package, store, transportation, and distribute. Furthermore, 10.9% use their mobile phones for marketing occasionally when harvesting season approaches. This reveals that the extent of use may undermine the benefit of using mobile phones for marketing information and hence influence marketing decisions.

Difficulty in the use of internet was found to be most limiting constraint while high cost of using mobile phone was found to be the least limiting constraint.

Recommendations

With respect to the conclusion of the socio-economic background characteristics, agricultural extension and NGO officers may create awareness through on farm exhibition and demonstration on the numerous benefits of using smartphones for marketing decisions, especially since 98% of small-holder food crop farmers have access to mobile phones, 69% of which are smartphones.

In reference to the findings and conclusions of the study, smallholder food crop farmers should be encouraged by stakeholders such as NGOs (SEND Foundation, etc.) and agricultural policy makers to adopt mobile phones. Although the revolution of ICTs in agriculture has not been driven by mobile phones alone, their ubiquitous mobility makes them a better tool than other alternatives such as radio, newspapers,

and TV, etc. However, mobile phones can be used complementarily with other AMITs but not as a total substitute for other Agricultural Marketing Information Tools (AMITs).

Governmental bodies through the ministry of food and agriculture and also private organisations interested in the welfare of smallholder food crop farmers must strengthen the FBO's by creating an enabling environment to attract smallholder food crop farmers to become members of FBO's and participate in their activities, leading to mobile phone adoption. The district Ministry of Food and Agriculture department can empower extensionists and FBOs for a quarterly workshop with smallholder farmers dubbed "Farming through Mobile Phones," where adequate empirical knowledge, skills, and information can be deeply inculcated.

Farmers must be encouraged through education by MoFA on the essentials of using smart mobile phones very often as operationally defined in the study. This will facilitate the extent to which mobile phones are used to improve marketing decisions by attaining accurate and timely information.

Extension officers and FBOs must intensify education for farmers on the usage of internet to make them internet usage friendly which can widen accurate and timely information scope to increase sales by improving decision making. Also, government and internet service providers may prioritize infrastructure development to ensure reliable and high speed internet connectivity reaches small holder food crop farmers. This may be done by investing in technology like fibre optic or satellite internet.

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APPENDIX

APPENDIX A

INTERVIEW SCHEDULE FOR SMALLHOLDER FOOD CROP (CASSAVA, PLANTAIN AND MAIZE) FARMERS

INTRODUCTION

Consent note; This survey is meant to elicit information from smallholder food crop farmers to enable the researcher ascertain the factors that influence the adoption of mobile phone for marketing information in the Assin North District. Your kind assistance would be greatly appreciated as your insight will provide the researcher with information on the influencing factors to shape the adoption of mobile phone. I want to assure you that information provided will be treated with outmost confidentiality and your identity will not be disclosed to any third party.

a. Questionnaire number/ID ……

b. Name of Community: ……

c. Date of Interview …….

d. Time interview started …….. Time interview ended ……

e. Enumerator's Name …….

SECTION A: Socio-Economic/Background Characteristics

1. Age …… years
2. Sex a. Male [ ] b. Female [ ]
3. How many people make up the household……?
4. What is your status in the household?] a. Head [ ] b.Spouse [ ] c. Child [ ]

5. Marital Status a. Married [ ]b. Single [ ] c.Divorced/Separated [ ] d. Widowed [ ] e. Others (Specify) …….

6. Form of education a. Formal [ ] b. Non formal [ ] c. None [ ] f. Others (Specify) …….

7. If formal, what is the highest level attained a. Primary[ ] b. J.H.S/J.S.S [ ]

   c. S.H.S/S.S.S [ ] d. A'level/O' level[ ] e. Tertiary [ ] f. others …….

8. Is farming your major occupation? a. Yes [ ] b. No [ ]

9. Number of years in farming ……..?
10. Do you have any occupation other than farming? a . I don't have any [ ] b.

    Other (Specify) ……

11. Do you engage in any off-farm activities? A. yes [ ] b. No [ ]

12. If yes to question 11, how much of the total income of your household comes

    from outside the farm?.....

13. Ethnicity a. Akans [ ] b. Ga-Adangbe [ ] c. Ashanti [ ] d. Ewe [ ] e.

    Dagomba [ ] f. Other, specify…….

14. Do you belong to any Farmer Based Organization? a. Yes [ ] b. No [ ]

15. Do you participate in any activities of the organization? a. yes [ ] b. [ ]

16. If yes in question 14, what benefit do you gain from the organization?

    ……

    ……

    ……..……..

17. What religion to you belong? a. Christian religion [ ] b. Muslim religion [ ]

    c. Traditional religion [ ] d. Others ……

18. How many years did you spend with respect to your education?

    ……

19. Do you have access to a mobile phone?

    a. Yes [ ]

    b. No [ ]

20. Do you own a mobile phone?

    A. Yes [ ] b. No [ ]

21. If the answer in 19 or 20 above is yes, what type of mobile phone do you own or have access to? (Tick all applicable).

    a. Smart phone [ ] b. Non-smart phone [ ]

22. Do you have access to the internet on your mobile phone?

    a. Yes [ ] b. No [ ]

23. Do you use the internet for agricultural information seeking?

    a. Yes [ ] b. No [ ]

24. Which network do you subscribe to? (Tick (√) all applicable) a. MTN [ ] b. Vodafone [ ] c. Airteltigo [ ] d. Other ……

25. How good is the Network reception in your area? a. Excellent [ ] b. Very good [ ] c. Good [ ] d. Bad[ ] e. Very bad [ ]

26. Which mobile agricultural information dissemination platforms are you aware of? (can tick more than one) a. TradeNet market [ ] b. Esoko [ ] c. Other (Specify)_____

27. Do you participate in farm training activities? Yes [ ] b. No[ ] If yes please state the provider of the training……

28. How many times have you had contact with extension officers ……

29. Do they give you any form of information regarding your food crop?
    a. Yes [ ] b. No[ ]
30. Do you have access to credit? a. Yes [ ] b. No [ ] if yes please state credit providers ..……..

31. Farm output and sales

Year	Type of food crop	Total quantity of output	Unit price per bag (GH¢)	Total output price (GH¢)	Quantity of output sold	Quantity of output consumed by household
2020						

32. What is your total agricultural land? ……

    acres

33. Do you have electricity at where you stay? 1. Yes [ ] 2. No[ ]

34. What is the distance in kilometers from your home to local market? …….

35. Do you use mobile phone to market your food crop? 1. Yes [ ] 2. No[ ]

36. If yes in question 32, what are the benefits of receiving agricultural information through the mobile phone?

    _____

    _____

37. Farmers Land/Labour characteristics

No.	Question	Response
1.	Do you own the land?	1. Yes 2. No
	If yes, how much land (in acres) do you own?	Own: _____ acres
2.	Do you rent land?	1. Yes 2. No
	If yes, how much land (in acres) do you rent?	Rent: _____ acres
3.	Do you borrow land for free	1. Yes 2. No
	If yes, If yes, how much land (in acres) do you borrow for free?	Borrow: _____acres
4.	What is the average wage per labour	
5.	Do you work as an agricultural laborer?	1. Yes 2. No
6.	Do you hire in labour?	1. Yes 2. No
7.	Number of labour (males, females	1. Male…….. 2. Female ……..
8.	How did you acquire the land you own?	1. Inherited 2. Purchased 3. Gift/Donation 4. Allocated/given by government 5. Other specify……

PART B: Identify and describe the AMITs used by smallholder farmers to assess information for marketing food crops

38.

Channel/Source	Choose 1-yes and 2-no whether you use any.	Kind of information received.	Information format	Spending on AMITs (monthly)
Tools Mobile phone Newspaper Television Radio Film show Others ……				
Sources Input dealers Extensionist Town criers Farmer union Other Farmers NGOs Others ……				

39. Are you able to personally read the messages in SMS format?

a. Yes [ ]

b. No [ ]

40. How many years have you been using AMITs to access market information ……years

41. Do you know of any agricultural programme that is broadcasted on radio or TV? 1. Yes [ ] 1. No [ ]

42. If yes, state the program and television or radio station you watch or listen to the program

……

……...

PART C: Extent of Use of mobile phone for marketing

43. Usefulness of mobile phone for marketing

Usage Mobile phone is used to access information on	**Tick all applicable**	**To what extent do you use it 1-never, 2-Rarely, 3-Sometimes, 4-Often, 5-Very often**
What and how to produce		
Harvest		
Assemble		
Grading		
Package		
Storage		
Transportation and distribution		

PART D: Influencing Variables to Adopt Mobile phone or not for Marketing information

State whether yes or no. Adoption of mobile phone (Adopter– 1[ ], Non adopter – 0[ ])

44. Does your age influence your decision? a. Yes b. No, what is your date of birth

……

45. Does your level of education influence your decision? a. Yes b. No, Number of years in schooling (formal) …….

46. Does your gender influence your decision? a. Yes b. No

47. Does your farm size influence your decision? a. Yes b. No, how many acres of land do you cultivate on ……?

48. Does your annual income influence your decision? a. Yes b. No, what is your total annual income ……?

49. Does access to credit influence your decision? a. Yes b. No

50. Is distance from farmer's home to local markets influencing your decision? a. Yes b. No

51. Is distance from farmer's home to electricity base influencing your decision? a. Yes b. No

52. Does your cultural values influence your decision? a. Yes b. No

53. Does your religion influence your decision? a. Yes b. No

54. Does your participation in Farmer-Based Organization influence your decision? a. Yes b. No

55. Does experience gained from farming influence your decision? a. Yes b. No, Number of years in farming …….

56. Does extension officer's contact with you influence your decision? a. Yes b. No, how many times in a month do you get into contact with Agricultural Extension Agents ……?

SECTION E: Constraints in Using Mobile Phone for Marketing information

57. On a scale of (1-5), rank the various constraints by assigning 1 to the most limiting constraint and 5 to the less limiting constraint in the use of mobile phone for marketing information by the farmer.

Constraints	**Rank**
Poor quality battery of mobile phones	
Internet use is difficult.	
Limited knowledge using mobile phones	
Mobile phone network problems	
High cost of using mobile phones	

Thank you for your time to answer this survey.