UNIVERSITY FOR DEVELOPMENT STUDIES

EFFECTS OF DEMAND DRIVEN AGRICULTURAL EXTENSION NEEDS ON MAIZE YIELD IN THE UPPER WEST REGION OF GHANA

ADINAANI NUHU

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OCTOBER, 2022

DECLARATION

Student

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

Signature ……...…… Date ……

Student: Adinaani Nuhu

Supervisor

I hereby declare that the preparation and presentation of the thesis was duly supervised in accordance with the guidelines on supervision of thesis laid down by the University for Development Studies.

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ABSTRACT

The dissatisfaction of traditional top-down agricultural extension information delivery has intensified for its lack of farmers concerns. This research examined the effects of demand driven agricultural extension information needs on maize yield in the Upper West Region of Ghana. Purposive sampling was used to select the districts and simple random sampling used in the selection of the communities and respondents. A total of 436 farmers and 25 extension agents were interviewed. The multivariate probit analysis, multinomial endogenous treatment effect, and the Kendall coefficient of concordance were used to analyse the data. The results from the multivariate probit regression revealed sex, age, education, household head, armyworm and PFJ as having significant positive effects whereas household size and off farm has negative effects on the usage of agricultural extension needs of farmers. The results from the multinomial endogenous treatment regression showed multiple and complementary usage of agricultural extension information needs. Except those who sought marketing information only, all other categorisation impacted positively and significantly on yield. Machine hours, chemicals, fertilizer, access to credit, improved seed, educational level, membership of FBO, were statistically significant and had positive effect on yield whilst household size and seed had significant negative effect on maize yield. The availability of agricultural extension information was the challenge of maize farmers whereas high extension-farmer ratio was the major challenge in delivering agricultural information to farmers. The study recommends targeting of agricultural information to addressing the multiple needs of farmers and training of more agricultural extension agents to improve the extension agent – farmer ratio.

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This work is dedicated to my late grandfather Alhaji Yakubu Siddique (Jamiat Chairman), my wife madam Sharifata Basiru and my children Yakubu Adinaani Mwini-Numbo and Mohammed Awal Adinaani Mwinin-Bang for their support throughout my educational carrier.

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LIST OF ACRONYMS

FAO	Food And Agriculture Organization
FBO	Farmer Based Organization
FFS	Farmer Field Schools
GDP	Gross Domestic Product
ICT	Information Communication Technology
MDG	Millennium Development Goals
MOFA	Ministry Of Food and Agriculture
MoFEP	Ministry Of Finance and Economic Planning
NDPC	National Development Planning Commission
NGO	Non-Governmental Organization
PHC	Population and Housing Census
SDG	Sustainable Development Goal
UWR	Upper West Region

CHAPTER ONE

INTRODUCTION

1.1 Background of the Study

In Africa, the leading economic activity patronized by most people is agriculture which contributes about 23% of sub-Saharan Africa's GDP (Chauvin, Mulangu, & Porto,2012). It employs greater number of the African population and also forms 30% of exports. The arable land in Africa is around 1,119 million hectares which corresponded to nearly 40% of the continent total land area (Jayne, Anriquez, & Collier,2013). For the past two years the sector recorded meaningful growth through the increasing of agricultural activities. Real Agricultural GDP increased from 2.9% in 2016 to 6.1% in 2017, recorded a growth of 4.8% in 2018 and 6.9 percent in 2019 (Amewu et al., 2020). The MoFA (2015) highlighted that about 50.6 percent of Ghana's labour force engaged in farming, fishing, forestry and hunting with about 51.8 percent contributed by women in 2009. Agriculture plays a key part of the country's economic growth. Yet its contribution to occupation, foreign exchange earnings, GDP and revenue to the government continue decreasing in recent times. The wide reduction in agricultural growth has been attributed to absence of access to credits and markets, low technological level particularly extension services, insufficient post-harvest arrangements (including processing, storage and transport), inadequate research discoveries by interested parties of advanced technology packages specifically planting resources and licensed seeds (MoFA, 2015).

Agricultural development is the leading employment supplier and a tool used in reducing poverty in the rural areas hence the need to curtail the challenges facing the industry. As posited by Porter & Goldman (2013), the key and fundamental factor in programmes and projects is argued to be agricultural extension services, articulated towards an enhanced agricultural growth and also enhance the standard of living of the poor in the rural areas. The provision of extension services via the field extension staffs are required to allocate verified and recognized methods to farmers in an effective means to support in securing funds to advance their production in an efficient manner. It is expected that the field extension teaches rural farmers issues regarding post-harvest processing and how to store foodstuffs. In the findings of MoFA (2015), such officers are also to provide access to market aid to help them obtain resources for their dealings, provide credit as well as a method to sell their extra harvest proceeds in order to cater for their families.

Considering the colossal role played by maize farmers, their quick and easy access to extension service is important for the achievement of Sustainable Development Goal 2 (SDG2) with the aim of "end hunger, achieve food security and improved nutrition and promote sustainable agriculture" (World Health Organization. 2015). It is noteworthy that many programs with good intentions especially in developing countries like Ghana, often overlook rural maize farmers' needs to access agricultural extension services, precisely due to policy makers, scholars and planner's absence of sufficient records, awareness of information and strategies to control them (Owusu Danquah et al., 2020).

In sub-Saharan Africa, the rural farmers form the larger part of the agricultural sector population in any developing country like Ghana. Governmental bodies and other stakeholders in developing nations have a focal role of making sure there is acceptable rural expansion in their numerous communities which results in effective and efficient agricultural systems that will not only provide food and animal protein but also raise the use of natural resources in a suitable method (Obidike, 2011). Bruce & Costa (2019) and Kamara et al. (2019) suggested that, the slightest luxurious contribution for an improve rural agricultural growth is tolerable access to extension services in area of early warning systems (pests, draughts and diseases), novel agricultural technologies, market prices, credit, fertilizer, improve seedlings and others. However, with rural farmer's absence of access to extension services that could have helped farmers attain a maximized agricultural return, they do not only fumble in the shade but then again are motivated to different centres of the urban area in search of formalized jobs, as a sole means of existence (Davis & Terblanche, 2016; Branco & Féres, 2021). The rural farmer stands the chance of benefiting from global agricultural services, if extension services are established in rural areas (Chen et al., 2021).

A recent study by Babu et al. (2011) found that maize farmers desire better extension services to enable them strategize their dealings, select desired inputs and ultimately on when and where to market their harvested products. That is, there exist a positive relation between extension service availability and agricultural development. Eventually, maize farmers need to have access to quality extension services for their productivity potentials to be realized if food security and self-sufficiency are to be

achieved. According to Adomi et al. (2010), farmers need to have access to quality extension services in order to improve their production. Therefore, extension service forms a key factor in all agricultural dealings. Agricultural extension provision is a must for every responsible government or policy makers because it is the only means maize farmers are informed, that they will be able to take a rational decision and produce enough to feed the rapid growing population of Ghana (Byswieza, J., 2016). Extension services in agriculture similarly add to the sustainability of agriculture, maintenance enlargement and the welfare of the populaces in the rural locations (Zwane & Davis, 2017; Meinzen-Dick et al., 2012)

1.2 Problem Statement

In Africa for many years, through extension officer's farmers usually access extension services yet the number of extension officers has been diminishing. This results to low accessibility of extension service in Africa with respect to reaching out to maize farmers with appropriate and significant agricultural information, meanwhile appropriate and significance information is vital in the sector in question (Kimaro et al., 2014).

The country`s rural maize farmers rely on home grown knowledge for advanced farming systems to increase yield. Such home-grown knowledge consists of talents and expert attained through spoken tradition and rehearsal for many generations (Obidike, 2011).

The attainment of such primitive experience by our food crop farmers particularly those in the Northern part of the country has not assisted to advance return in the agricultural sector. As a result, the rural agricultural system has been recording poor farm yield, the

arrival of new crop diseases, pest that attack farm crops, resilient plant weeds, old farm kits, reduced quality of fertilizer and others. Rural farmers especially, maize farmers received agricultural extension services from extension workers, radio, television, community libraries, agricultural paperwork, agricultural bodies and film shows (Meitei & Devi, 2014; Mtega & Benard, 2016). Maize farmers in their efforts to access these extension service from available sources for advanced systems of farming and better agricultural returns are faced with restrictions (Norton & Alwang, 2020).

Most farmers in Upper West Region are smallholders cultivating maize, millet, cassava, sorghum and legumes as food crops (Assembly, 2015). But the Region is not producing sufficient food to sustain the nutritional needs of the populace because of some restrictions that results from the absence of access to appropriate updated information that would enable them attain optimum returns from their pastures. Extension services are extremely preferred by farmers that can access them only through agricultural extension agents, community libraries and through the World Wide Web (Norton & Alwang, 2020).

The absence of access to extension services by farmers in rural areas could be as a result of definite restrictions that have resulted in the farmers sticking to their outdated methods of farming system, hence resulting in poor yield (Churi et al., 2012). Extension services are key to agricultural development in any community and where there is poor dissemination due to definite restrictions, the community`s agricultural advancement is heavily obstructed. In a study by Stefane et al. (2013) the need for information on maize yield varied from time to time because of environmental changes and changes in

agricultural technologies. The information needs of maize farmers change from time to time due to changing agricultural technologies, the emergence of agricultural interventions, and agricultural policies.

In the early 2000s, the calls by concerned individuals and institutions for a relook at the traditional top-down agricultural extension information delivery intensified for its lack of farmers concerns (Kingiri, 2021). This was the rationale in Badu et al. (2011) study that suggested that advanced knowledge of farmer`s agricultural desires and bases could assist extension and other related agricultural programmes to enhance targeting of specific needs of maize farmers to increase maize yields. As Christoplos (2010) said agricultural extension is the "amorphous umbrella term for all the different activities that provide information and advisory services that are needed and demanded by farmers and other actors in agri-food systems and rural development". This is simply called demand-driven extension services, which is defined as the concept of providing extension services based on the needs and priorities of farmers (Kilelu et al., 2014; Qamar, 2011). The demand-driven extension services enable extensionists to adapt to the changing needs of farmers in terms of agricultural technologies, environmental changes, agricultural policies, and the emergence of agricultural innovations (Bitzer et al., 2019). Also, the demand delivery approach is found to increase access to extension services especially among women (Williams & Taron, 2020). This means that, none of the traditional assessment of the impact of extension services using the traditional top-down approach or "the number of extension contacts" or the dichotomous "access or not accessed" is capable of taking care of the extension that is demand-driven. So, this

study assessed the effects of demand driven agricultural extension information needs on maize yield in the Upper West Region of Ghana.

1.3 Research Questions

The central question that forms the basis of this study is: how does the delivery of demand driven agricultural extension information needs affect maize yield in the Upper West Region?

The specific questions include:

1. What factors determine the demand driven agricultural extension needs of maize farmers in the Upper West Region?
2. What are the effects of demand driven agricultural extension needs delivery on maize farmers' yield in the Upper West Region?
3. What are the challenges of agricultural extension delivery and access in the Upper West?

   Region?

1.4 Research Objectives

The main objective is to assess the effect of demand driven agricultural extension needs on maize farmers' yield in the Upper West Region.

Specifically, the research seeks to;

1. Identify the determinants of demand driven agricultural extension needs of maize farmers in the Upper West Region
2. Assess the effects of demand driven agricultural extension needs on maize farmers' yield in the Upper West Region

3. Identify the challenges of agricultural extension delivery and access in the Upper West Region

1.5 Significance of the Study

The country`s larger part of the population lives in the rural part with agriculture as their dominant economic activity. The rural part produces the country`s major output of food but the living standard of the rural population needs to be improved. A key means to attain this is a cautiously strategized and applied extension services approach to accelerate the pace of agricultural advancing for sufficient returns as means of increasing maize yield. Among the aims of the provision of extension services is to relocate advanced agricultural technology to the farmers targeting their specific extension information needs and provide assistance for them to be able to access micro funds and easy access to the market to aid productivity as well as wealth creation to improve their standard of living as stated by Anang, et al., (2020).

The findings of the study will highlight the effectiveness of the factors that determine access to extension service needs in rural Ghana such as production information, post-harvest storage information and marketing information on maize farmer's yield. This will allow them to understand the relevance of improved approaches to agriculture and henceforth be in the capacity to perfectly use their available and prospective resources to complement other extension services (Adekunle, 2013). This study intends to also offer substantiation grounded on operational assessment of the productivity of early and timely delivery of extension service needs to maize farmers. Hence, it predicts that the

research will again assist the Government and policy makers for policies and programs that will offer the needed extension services to farmers specifically maize farmers to increase yields. This will lead to the improvement in agricultural productivity and sustainability in the country. Again, the study will assist maize farmers to appropriately make use of information and technology, access knowledge that they desired for their farming dealings.

1.6 Scope of the Study

The study covered extensive literature on the various extension services and productivity policies implemented around the world. It considered various policies, programs and projects implemented in Ghana and the Upper West Region in particular. Journals, Articles and conference papers regarding extension services, livelihoods and productivity have all been contacted as well.

Geographically, the study holistically looked at demand driven extension needs in the agricultural sector and its effect on maize yield across the entire Ghana placing emphasis on the Upper West Region which is agrarian. The study also looked into the various kinds of productivity initiatives and projects that have been spread across the country. It has narrowed down its study area to the Upper West Region concentrating on some selected districts.

1.7 Organization of the Study

This study is divided into five chapters with chapter one made up of introduction comprising the background, problem statement, research questions, research objectives,

significance of the study, and the organization. The chapter two contains the literature review. In that area, the study reviewed literature on factors determining maize farmers' access to agricultural extension information needs, effects of demand driven agricultural information needs on maize yield and constraints faced in accessing and delivering agricultural extension information needs by maize farmers and extension officers respectively in the Upper West Region. Chapter three is made up of the study area (Upper West) profile with its components being area demographic characteristics, area socio-economic characteristics, area economic activities, detail research methodology and other sectors relevant to the study area. Chapter four is the in-depth analysis and presentation of data while chapter five takes care of the finding, summary, conclusion and recommendations.

CHAPTER TWO

LITERATURE REVIEW

2.1 Introduction

This chapter of the study is considered as the literature. In this regard, the chapter critically reviewed extensive literature on maize farmer's access to their extension needs and its impact on maize yield. The chapter has been categorized into different sub-sections capturing theoretical and conceptual frameworks underpinning the study. It further reviewed empirical studies on the factors that determine farmers' access to agricultural extension information, the effects of agricultural extension information needs on maize yield and constraints faced by maize farmers and agricultural extension officers in accessing and delivering agricultural extension information respectively in the Upper West Region.

2.2 History of Agricultural Extension

During the 19th century in the second half the word extension was principally used to designate adult education programs in the United Kingdom specifically England. These educational programs facilitated universities work to extend further than their university premises and into the neighbouring countries (Diab et al., 2020). The term was subsequently implemented in the United States with the creation of land grant universities with its official mandate encompassed research and extension activities. In the 1914, the Britain administrative government officially transferred extension responsibilities to the Ministry of Agriculture. However, the term for this new responsibility was altered to advisory services in the 20th century (Diab et al., 2020).

Extension service was now a popular terminology used in majority of European nations as they established similar advisory services within their respective Agriculture ministry.

In almost all low-income nations, the term used to establish agricultural extension service was commonly related with the donor agency that facilitated the establishment of the services. In 1960s and 1970s, the USAID played a critical role in the establishment of agricultural universities and extension systems (Diab et al., 2020). Nonetheless, almost all extension systems across the world be it Asia, Europe, Africa and others are formally associated with their respective Ministry of Agriculture. Globally, people associated extension services more with the transfer of technology, improving the management, technical as well as the social capital skills of household farms. In the 20th century era, majority of public extension systems in low-income nations were centrally funded and top-down structure. The primary concentration at that time was mainly on nationwide food security at the expense of extension agencies that make used of the availability of green revolution technologies. In the 1990s, the world witnessed a tremendous increase in a global supply of major food crops. However, this success was short change with the continuous decline in world food prices in the 1980s and 1990s hence making small scale farmers worst off in terms of their income generation (Diab et al., 2020).

The 1996 World Food Summit was a major event that contributed significantly in redesigning the concept of food security with major focus on individual and household food security, showcasing its access and nutritional dimensions (Diab et al., 2020). The

rapid increase of vegetables, fruit and livestock demand in India and China, as well as an increase in biofuels from food crops in the United States, Europe, Asia and South America is now having a significant and potential long-term effect on world food price index (Tadasse et al., 2016). Similarly, the record of high increased in the prices of gas and oil had directly contributed to the upward shift in prices for key agricultural inputs such as insecticides, fertilizer as well as fuel (Diab et al., 2020). There exists also a growing alarm with regard to the effect of changes in climate as well as the rapid degradation of natural resources in many Low-income nations and that of countries within Sub-Saharan Africa. All these emerging trends have consequences on access to food by the needy which eventual affect their nutrition. Deducing from this, many nations and donors are redeploying their attention and resources on improving agricultural extension activities for the reason that they have seen extension as the ultimate source that can improve people livelihoods by impacting knowledge on them about farming activities as well as how to tackle climate changes in order to attain food security (Ferris et al., 2014).

2.3 Definition of Basic Terms

There exists no single acknowledged explanation on agricultural extension. Economist policy makers and farmers perceive agricultural extension differently depending on how they comprehend it. For instance, farmers see extension to be a practice of aid to help advance their technical Know-how, efficiency, productivity, profit margin and contribution as well to the benefit of their communities, societies and families. Policy makers recognized agricultural extension as a policy instrument that have the capacity

to improve and increase the quality of agricultural production, have the ability to achieve food security as well as to help alleviate rural poverty (Van Den Ban & Hawkins, 2010; Oladela, 2011).

Kumar and Tripathi (2014) defined the term agricultural extension as a science or assistance to farmers to help themselves towards some desirable direction through consistent learning process by engaging themselves physical in the process. As noted by Ali et al. (2011) agricultural extension encapsulates the complete set of firms that assist and enhance people involved in agricultural productivity to address issues and to gain skills, technologies and information to increase their standard of living (Ali et al., 2011). Agricultural extension extends information from local and global research to farmers through accelerating information transmission and assisting farmers become advanced managers (Huffman, 2017). Extension is the vital ways through which new information and concepts are presented into rural sections to lead to a change and improve the standard of living of the farmers (Sayed & Shukrullah, 2019).

2.4 Types of extension

Literature theorized that extension services are grouped into three main types based on those that provide the service (Jayne, 2008). They argued the Government sectors, private sector as well as the Non-Governmental Organizations (NGOs) are regarded as the service providers that provide extension service.

2.4.1 Government extension services

Government extension services are offered through public agencies and are considered as moderately cheap due to the cost of accessing them. Government extension services by nature are long term and reach several farmers enhancing their impact. Conversely, they are occasionally not reliable due to the fact that they are restricted through bureaucracy and scanty funds (Adekunle, 2013).

2.4.2 Private extension services

In the book of Mukherjee & Maity, (2015) entitled "Public–private partnership for convergence of extension services". Private extension services are offered by money-making companies for proceeds. They mostly focus on well-educated farmers with moderately high income due to their ability to afford them. Accordingly, the services are well financed and effective as related to the services provided by the Government. However, they only cover narrow geographical sections and reach out to small number of farmers to the neglect of the poor farmers who forms the majority.

2.4.3 NGOs extension services

Kumar et al. (2018) reflects NGOs extension services as an isolated category yet Muyanga and Jayne (2008) deliberates that they form part of private extension. With regards to this study, farmers reported that they accessed the three forms of extension services. Therefore, it was reasonable to cite them as different. The key power of the NGO extension services is that they are relatively cheap to afford and cover a broader geographic section as related to the services of the private extension. However, NGO

extension services are established on short term schemes restricting their influence on focused farmers (Adekunle, 2013).

2.5 Agricultural Extension Information Channels

Communication plays an important part in the development of every society including the agricultural sector. The channels of communication are many and not the same. None of the channels can fit all situations alone. These communication channels are broadly grouped into two major channels. Thus, interpersonal communication channels and non-interpersonal communication channels. There are a number of factors that determine farmers' choice of communication channel. These include cost, availability and suitability of the channel, nature of message, and the farmer's expectation or preference (Ofori-Dwumfuo & Salakpi, 2011).

2.5.1 Interpersonal Communication Channels:

These include personal contact between the receiver and the source of the information such as extension agent, contact/lead farmers, opinion leaders, friends and family, field demonstrations

2.5.2 Non- Interpersonal Communication Channels:

These are the ways of transferring information to farmers without confrontation between the receiver and the source of the information. They are radio, television, phone call, posters, newspapers, film shows, internet, and social media.

2.6 Structure of Agricultural Extension Delivery in Ghana

There is a central national body called Directorate of Agricultural Extension Service (DAES) mandated by government to oversee the activities of agricultural extension in the country. This agency also delegated the operation of its activities to regional and district offices and also collaborate with non-governmental organizations (NGOs). DAES draws policies and guidelines which are passed to the regional and district offices for implementation. The various regional and district offices on the ground also work with the private sector comprising NGOs, Community Based Organizations (CBOs) and other stakeholders for the successful achievement of the set policies using the guidelines provided by the central body (Bonye et al., 2012)

According to Bonye et al. (2012) DAES has some major duties as stated below:

- To Plan and formulate extension policies
- To collaborate with other organizations or agencies like NGOs, private service providers, other public organizations in providing extension service
- To promote a strong research -extension – farmer linkages
- To provide technical support to the regional and district to plan and implement extension activities
- To provide logistics to all field staff in the country
- To monitor and evaluate all extension activities under Ministry of Food and Agriculture
- To adopt best extension methodologies for efficient and effective service delivery

- To effectively collaborate with other stakeholders in extension service delivery

2.7 Importance of extension to agriculture

Information is very important in the development of any society. For farmers to be able realize the benefits of their work, they need correct and timely information in three major areas namely production information, post-harvest storage information and marketing information. This information's are very essential in reducing the poverty level of every farmer. Farmers in most cases get this information from agricultural extension agents who works and aim at reducing poverty and enhance community involvement in development process (Kingiri, 2021). Extension service constituent transferring agricultural information to farmers which the farmer absorbs and apply in his / her farm.

2.8 The effects of agricultural extension on the farm and farm household

2.8.1 Yield

Information leads to agricultural development through the increment of agricultural production and improving marketing and distribution strategies. Agricultural extension is highly relying on exchange of information. The present study tries to identify the effects of demand driven agricultural information needs on maize yield (Leeuwis, 2013; Rehman et al., 2011).

2.8.2 Output

Agricultural extension programmes are important channels of eradicating poverty and enhancing food security because it provides essential farming information to rural adults

who learn and use it in solving their farming problems. It also introduces new technology to farmers and encourages their effective involvement in knowledge and information exercises (Ehiakpor et al., 2016). Bonye et al. (2012) argued that extension service enhances standard of living, increase income and production through the application of the new technology the adopters learned.

Extension service providers assist farm households to be innovative making them increasing adoption rate and prevent individuals from stopping the diffusion process (Alemu et al., 2016). Extension officers after demonstrating a technology to the farmers, encourages them to adopt it early for anyone not to be laggard or be learning it later from the colleague. It is through extension service that farmer problems are identified, investigated and help in policy formulation

2.9 Adoption of agricultural technologies

The adoption of every new technology depends on whether it conforms with the needs of the farmers. The adoption of a technology passes through stages. The farmer has to first decide whether to adopt or not to adopt. When the decision to adopt is taken, the intensity stage then comes in (Altalb et al., 2015). However, there are other factors that might prevent some farmers from adopting a technology. For instance, if fee is attached which the farmer cannot afford, that particular farmer cannot adopt. On the other hand, your relation with the extension officer will determine whether to adopt new technologies or even the intensity of adoption (Asarat et al., 2016; Ghimire et al., 2015). For instance, the sources of information for a smallholder farmer might come from different training centres with varying distances. This will press the farmer to decide

where to go depending on his needs or distance of the training centre. Gillespie et al. (2014) said the adoption of new technology is encouraged by socio-economic factors such as age, education, diversification, and farm size whiles others expressed the effect of socio-economic characteristics on the intensity of adoption of technology only.

2.10 Demand driven extension

2.10.1 History of Demand Driven Extension

Demand driven to the economists has to do with demand and supply. In economic theory, demand is the amount of goods and services a consumer is willing and able to buy at a specific price within a given period of time. The term demand driven is referring to change from the old way of top-down approach of providing agricultural information to a more result-oriented way by taking the farmer needs into consideration (Lourenço et al., 2016). The change takes farmers welfare and concerns into account in the provision of agricultural extension services increasing its efficiency and enhance transparency in public service provision. The concentration of demand driven service is not confined to only agricultural extension but has been extended to many other sectors. There are still plans in the pipeline to make community water, health care and education demand driven.

2.10.2 Importance of demand driven extension

2.10.2.1 Market-based solutions

After harvest most farmers faced the problem of finding market for their farm produce. When agricultural extension information turns to be demand delivery, markets within the country will be made known to farmers who inform their extension officer of their

intention to sell their farm produce that will help in providing solutions to market-based problems. The farmers know the specific problems they encounter on the side of marketing their farm produce. When extension turn to be demand driven it will provide solutions to farmers' individual specific challenges. This will help to ensure sustainability as private sector extension is interested in getting pay for their service rendered and the farmers are also interested in getting their challenges solved. Inclusive market will be achieved when the specific needs of farmers are addressed (Asres et al., 2013).

2.10.2.2 Helping women farmers

There is the need to consider needs of youth with special attention to women and also try to address their unique challenges. Their domestic responsibilities serve as a challenge to them by restricting their mobility and time available to do other things. Also, women do not have easy access to land compared to their male counterparts and negative conduct of some society members about women capabilities also cripple their success (Danso-Abbeam, 2018).

2.10.2.3 Effectiveness of public-private partnerships.

For an effective development to take place, there should be collaboration between government and the private sector. This collaboration will bring different expertise and abilities together. Since one ability might be the defect of the other, a collaboration between the two sectors will bring total development. For instance, through collaboration traditional leaders might provide land for government to execute it

developmental project. Many successful initiatives feature collaboration among different types of development partners (Dhehibi, 2018).

2.10.2.4 Differentiating among youth

The various farming households should be viewed as heterogeneous. The needy, poor, vulnerable, less educated, rich and highly educated should all be segregated. These enable development agents to plan for all of them. The inclusion of the needs of all these group of people will make the plan universally inclusive serving as a motivation for all categories of farmers to participate in whatever adoption strategy a particular training is about. Such a plan stands the chance of bringing positive changes and enhance development (Mabe et al., 2018). But in most cases the reverse is seen.

Moreover, agricultural extension has encountered a number of challenges in both accessing and delivery such as how to form a faultless system to suit the aspirations of majority of farmers involved in different but complex farming systems, the associated problems of monitoring and evaluating extension services and scrutinizing the effects, the reliance of extension on the performance and its resultant linkages, and inherent challenges of ensuring political commitment and fiscal accountability of agricultural extension (Zong et al., 2021).

2.11 Current state of extension in Ghana

In Ghana, agricultural extension had passed through a numerous political transition through export commodity expansion approach prior to liberation to advanced production of food crop. The Government of Ghana for the earlier four decades has

gradually shifted from traditional prominence on technological transfer and the management of farm information provided through the government part to the general public and private body service approach, solving critical subjects like risk management by farmers, marketing of agricultural products, pest diagnostics and environmental sustainability (Norton & Alwang, 2020). As a result of this transition the government of Ghana trained personnel from the ministry of food and agriculture to solve the peasant`s needs of extension or non-commercial and commercial farmers.

In Ghana presently, approaches to agricultural extension have moved from top to down community approach to more engaging approach. The shift is in conformity with the world Banks training and visit (T&V), product engaging methods, the farmer field schools (FFSs), mobile phone promotion to farmers and radio station in the communities to sensitize farmers on agricultural best practice and the innovative Information Communication Technology (ICT) which seek to provide reasonable advice to farmers on-line (Cook et al., 2021).

Due to a number of explanations, globally systems of extension have increasingly developed more diverse within a short period, depending on numerous transfer instruments and substitutes financing means both publicly and privately (Bitzer et al., 2016; Davis & Franzel, 2018). In Ghana, the introduction of innovative ICT has reduced the restrictions on the spread of information, delicately fluctuating extension roles away from the normally massage transfer towards a robust converting systematic advance to produce more and easily reachable to the ordinary and commercial farmers (World Bank, 2017).

2.12 Policy interventions towards extension

2.12.1 Structural Innovation Policy

As part of the overwhelming success of research in agriculture and extension, the rate of productivity in agricultural development had led to the transformation of many nations' economies, with the non-farm employment and income increasing comparatively to agricultural employment and income (Norton & Alwang, 2020). The expansion of non-farm sector directly corresponds to the expansion of commercialization of farms to meet the increasing demand of agricultural products both in quantity and quality. The agricultural sector is dual in nature with most of the small but growing profitable farms which are smaller semi-subsistence farms in nature are normally found in Low-Income earning nations. However, the developed nations are characterized with commercial farms with some been smaller and part-time in nature.

Commercialization of farms in essence increased the demand for client-specific extension information which is mostly delivered through privately owned firms (Guarín et al., 2020). Generally, farm workers seek data that tend to improve their agricultural productivity, market their products and other decision that would increase their profit margin as well. This type of information required by individual farm and field specific are normally provided by input suppliers and private advisory services. With the growing degree of individual desired for information had made it a profit incentive business where private firms increasingly sell data openly to farmer or inserted in inputs. With the privatization of extension, public extension services are generally turning to transmit their contributions in other matters like the need for non-commercial and

farmers who operate on small scale bases, elucidate environmental and natural resources issues for which data of such are regarded as public goods (Norton & Alwang, 2020). In advanced nations, the extension service had witnessed a greater shift of emphasis than the less advanced nations however the shifting directive for public extension is a worldwide occurrence.

2.12.2 Agricultural Technology and Information Innovative Policy

Agricultural data may be useful in the acquisition of inputs like farming machinery, improved seedlings as well as bio-pesticides, again agricultural information provide useful information about agricultural markets and practices (Anderson & Feder, 2007). Disembodied data may be a chargeable good either publicly or privately. Disembodied information Public good include information concerning weather-based crop-disease prediction and market trends whereas that of privately chargeable goods is made up of information about pest diagnoses and fertilizer recommendation for specific farms and plots (Anderson & Feder, 2007). Globally the percentage of information surrounded in inputs has risen over a short period as materials and capital expenditures have enormously ballooned. Developed and developing nations had witnessed a significant increase in the farm specific demand for service fee from private firms and such demands for services are mostly demanded by profit making large firms (Norton & Alwang, 2020). Majority of public agricultural extension services within the United States charge fees for the services rendered to commercial farmers, likewise in Mexico and Nicaragua, a fee for service system is developed for large scale farm workers (Norton & Alwang, 2020). Again, in Honduras, an estimated percentage of 9 of the total

coast of extension services is born by large scale farmers (Valenzuela & Saavedra, 2017).

The privately operated extension division has recently been encouraging to perform a significant duty in the propagating of data on agricultural than what it previously did when large amount of data dissemination existed and propagated by publicly operated property. With the continuous increased in the involvement of private agricultural extension sector in the dissemination of agricultural information the public agricultural extension sector had change its size, structure and emphasis (Norton & Alwang, 2020). In most developing nations in some instances, the role of the public extensions service is replaced by Non-Governmental Organizations even though majority of the Non-Governmental Organizations (NGOs) are partly maintained through state funds and that of privately advised services (Norton & Alwang, 2020). Globally, agricultural extension services had witnessed a bit of transformation slowly towards gender equality. Studies have indicated that agricultural extension services over the past four decades are much aware with gender bias challenge affecting agricultural productivity negatively (Quisumbing et al., 2014; Jafry & Sulaiman, 2013). However, in the 21st century, the narrative has changed with almost every nation giving room for women to involve in extension activities and they are as well participate in the decision-making process (Quisumbing et al., 2014; Rola-Rubzen, et al., 2020).

2.12.3 Communication and Information Technology (ICT) Policy

The ICT policy has reached a point where majority of farmers have owned cell phones that agricultural extension systems can target a large population of farmers without

incurring much cost and timely delivery of agricultural information (Aker, 2011). The insufficient resources in most developing nations remain a disadvantage to farmers with regard to the ownership of definite categories of mass media hardware thus smartphones and computers, however agricultural systems of extension are increasingly gaining subscribers for a large collection of mass media programming large- and small-scale profit-making farm workers. Almost the entire messages transmitted via ICT are easier than the ones conveyed by the means of face-to-face teaching despite this, the number of farm workers gotten by extension service via ICT is rapidly growing and the cost involve is minimal. Aker (2011) and Larochelle et al. (2019) theorized ICT enable extension service to provide farmers with information concerning insect and disease diagnoses, information on agricultural markets, when to start farming and how to adopt effective agricultural practices.

2.12.4 Financial Support Policy

In the 1970s and 1980s, the agricultural extension has received enormous amount of support from international and governmental donors. However, in many nations' agricultural extension services in present day have seen a continuous declined with regards to support (Davis et al., 2019). According to Anderson and Feder (2007), in the 1980s and 1990s, the financial resource was provided by World Bank for its training and visit to quite number of nations. Nonetheless, even though the Training and Visit system was not capital intensive during the 1990s, the public debt crises that hit various nations especially Africa and Latin America, their national government were forced by donor nations to cut their fiscal deficits and this has led to the reduction of funds for

extension activities. Agriculture share of the world economy keep on dwindling; however, urbanization was speedily increasing, investment in the publicly owned resources like roads, water and irrigation system were largely increased resulting in the neglect of supporting agricultural extension by central governments and donors (Norton & Alwang, 2020). The hope that private sector will take up the mantle to adequately support and fund extension service was achieved in directed fashion.

2.12.5 Government Decentralization Policy

Nations such as Uganda, Philippines, Ghana, Columbia, Nepal and others have decentralized their government services as well as their publicly operated agriculture extension services. There is decentralization when specific administrative function services are delegated from the central government bodies to the local government bodies. Decentralization increased the independence of local government institutions from the centre, nevertheless its demands reorganization of public services like the extension units (Norton & Alwang, 2020). Extension officers that are within the district level only report to their immediate boss at the district level who in turn also report to the regional administrators and vice visa. A reason for this derives change is to have extension units whose works are motivated by farmers' desire and also to make them answerable to officers who are nominated locally. Government local bodies are general perceived to support extension programs through the use of incentives and financial support, however the perceived support is limited by the lack of funds hence possess a foremost challenge for numerous systems of extension. Notwithstanding, the element of decentralizing extension systems expedite productivity as well as the delivery of site-

specific information (Norton & Alwang, 2020). A significant drawback in decentralization is that extension workers are observed to be driven by politics or taken as government eyes and ears rather than objective transmitters of agricultural information. In the developed nations especially the United States there is evidence that decentralization has work quite well where extensions services are closely connected to decentralized state institutions as well as state academia investigation structure. Government local bodies assist in sharing the trouble of financing workers of local extensions, the state level specialist backstop.

In Low-Income nations, the impact of extensions been decentralized has encountered diverse opinions. For instance, in Uganda, the term has played a significant role in improving control and participation of local communities' delivery of extension services. Notwithstanding this, programs of extension services are stagnant with challenges in inadequate funds from local sources, over the reliance on conditions and unrealistic grants from Government, unable to remain and attract staff as well as bribery and capture by local leaders (Bashaasha et al., 2011).

2.13 Factors that determines access to the various forms of agricultural information needs among food crops farmers

Agriculture is the pillar of the global economy and a source of getting funds for about 50% of the world population (Oladipo et al., 2019; Elly & Silayo, 2013). Ghana is an agrarian country with a lot of natural resources, good climate, fertile soil, suitable topography and water resources giving her the opportunity for crop and livestock production (Mogues et al., 2012). Agriculture plays a major role in Ghana's economic

growth employing 70% of the total labour force of the country. But comparing Ghana to other countries, our economic growth is still being not one of the best in the world (Ragasa et al., 2014). This low yield as a result of most farmers not willing to change their old way of doing things and also improper way of managing the farm (Barnes et al., 2019). Rapini et al. (2017) and Rehman et al. (2011) argue that the absence of good information to adapt and unskilled technical personnel are the cause of it. Agriculture sees information as a major factor responsible for development which helps farmers to develop the rural area and also make wise decisions for other development related to farming (Beza et al., 2017).

Agricultural extension is believed to be a transmitter of agricultural knowledge (Benson & Jafry, 2013). With the intension of getting a resourceful knowledge and behaviour changes generated through research practices by farmers. It is a way of bringing enviable changes in the attitude of farmers to encourage them to adopt new ideas relating to agriculture making sure it will satisfy them (Leeuwis, 2013). Thus, agricultural extension organizations are giving the mandate to impart knowledge to farmers and spread new agricultural technologies through various teaching methods including single persons, team, mass media and Print media which is comparatively less costly, durable, and covers wide range of areas making it most suitable for farmers (Rehman et al., 2011).

2.14 The constraints faced in accessing and delivering agricultural information

The main challenges facing agricultural extension service delivery in both the past and present are the top-down approach of delivering the information, ambiguous extension

approach, absence of adapting technology packages to suit local conditions, absence of the national framework of agricultural extension policy that has been developed in a participatory manner,

Several restructuring of the extension institutions, incompetency of field and technical staff, insufficient budget for the implementation of the extension system, inadequate private sector participation in service delivery, managers unnecessary involving themselves in technical issues, inadequate supervision and evaluation of the extension service, reluctant in the supply of agricultural inputs, (seeds, fertilizer, credit, subsidies etc.) and distribution systems, inclusion of technical know-how people on duties other than extension responsibility, limited linkage of markets and information systems, limited coordination of research - extension farmer, no collaboration between public sector and the private sector in extension service delivery ,Inadequate attention given to indigenous knowledge of local people and lack of irrigated agriculture focused extension and research systems (Belay and Dawit, 2017). Moreover; According to Mengistie and Belete (2015) the current extension challenges are the top-down approach nature of delivery, low staff morale, incompetency of staff, involvement of officers in different activities, insufficient technology and inadequate funding. In the study area the major challenges of the current agricultural extension service are grouped into two. Thus, those affecting farmers' access to extension service and those affecting extension officers' delivery of extension service.

2.14.1 The constraints food crop farmers faced in accessing agricultural extension information

2.14.1.1 Availability of Extension needs

There are still low yields of crops as compared to the estimated research managed plot yields (Egbule et al., 2013). It is as a result of research extension that considers all extension methods to fit all categories of adopters meanwhile there is no extension that suits all categories of adopters (Albore, 2018). The availability of the extension needs of farmers is very important in increasing the yields of the farmers. The limitation of the needs of farmers will limit the contribution of agricultural extension to the growth of agricultural output and productivity (Birhanu & Sekar, 2016).

2.14.1.2 Top-down/non-participatory/supply driven

According to Boyaci and Yildiz (2016), successful agricultural advisory systems incorporate and integrate farmers' traditional knowledge into the research process and see farmers as decision-making partners. Many scientists consider their knowledge to be unscientific and primitive. To improve this rural population, formal research and extension must translate their knowledge into other knowledge systems (Körhasan & Wang, 2016). This is the situation in Ethiopia for agricultural extension. Majority of the time, the method is top-down, with technology produced somewhere and development organisations telling farmers what to do (Albore, 2018). Inadequate research-extension collaboration. Earlier empirical studies in developing countries, according to Belay and Dawit (2017), identified weak links between research and extension as the major factor limiting the flow of information, knowledge, useful new technologies, and resources

among actors in the technology-delivery utilisation system and recommend measures to overcome widely acknowledged weaknesses (Asiabaka et al., 2012). Under normal circumstances, agricultural extension service functions as a farmer organisation, expressing farmers' concerns and feelings to the public and conveying information from research institutes to farmers and farmers back to research institutes (Boubacar & Foster, 2014). Despite this, agricultural research in Ethiopia is inadequately linked to extension (Albore, 2018) since extension and research operations have been separated. carried out under different institutions with zero or minimal coordination between them.

2.14.1.3 Lack of qualified extension supervisors and worker

According to Albore (2018). With government controlling its expenditure, most budgets are cut to a sizeable limit without taking into consideration available needs. This budget constraint limits the number of extension workers to be trained giving quotas to the training institutions. Therefore, causing the shortage of extension supervisors or workers. It also leads to the training institutions not having the required equipment to use in training the officers. This led to personnel having insufficient knowledge on the subject area. Thus, the transfer of required information to farmers and also report the problems faced by the farmers will not work effectively (Swanson et al., 2014).

2.14.1.4 Improper Policy Focus

The access to agricultural extension service is limited to the well to do farmers. The paying of a fee before accessing a new technology has made poor farmers not being able to adopt such technologies (Francis & Addom, 2014). On the other hand, other services

are not valued by some group of farmers because they are free. This is the case because the well to do farmers who are willing and able to pay for any service never access the technology that is free. (Devkota et al., 2016).

2.14.1.5 Weak Legislation on Agricultural Extension Services

Government laws and policies do not encourage the growing of certain crops. Much attention is always given to crops that can boast their foreign exchange such as cotton and cocoa to the neglect of some other crops like maize and millet (Devkota et al., 2016). This restricts farmers from diversifying to follow climate change because they want to produce essential crop that will send them to international market. This is killing the creative ability of the farmers. Also, much attention is given to large scale farmers to the disadvantage of the smaller majority of the farmers (Devkota et al., 2016).

2.14.2 Challenges Extension Officers Faced in delivering extension services

The major constraints faced by extension officers in the study area include Absence or Inadequate field allowance, transportation, communication, safety and security, cost of delivery, high extension- farmer ratio, and difficulty in meeting the farmers.

2.14.2.1 Absence or Inadequate Field Allowance

Extension officer- farmer ratio is high making it difficult for the officers to reach all farmers in good time as well as deliver timely information to farmers. This coupling with the absence or inadequate field allowance to extension officers makes them reluctant to stress themselves leaving most farmers unattended to. The field allowance

would have served as a motivation for the officers to work extra more to cover most farmers (Mruma, 2013).

2.14.2.2 Transportation

In livestock and agricultural extension services, the arrangements of transport is insufficient in many Africa countries especially in Ghana and Kenya (Devkota et al., 2016). Due to the inadequacy of transport facilities many agricultural extensions services resort to group extension approaches such as farmers field days and chief's Barazans (public gathering). In the study of Francis and Addom (2014), he proclaimed that the acquisition of new transport facilities will cushion the transportation challenges extension services confront in exercising their responsibilities. In many parts of the African continent, several extension officers perform their responsibilities either by foot, bicycles or borrowed motor bikes to informed farmers about best agricultural practices so as to increase their farm yields (Francis & Addom, 2014).

2.14.2.3 Cost of Delivery

One major challenge facing agricultural extension service is insufficient budget on the side of government. This makes the public extension officers unable to execute all their plans. With this, farmers resort to seek the services of private extension officers increasing their cost of investment into the farm meanwhile that service is still not enough to the farmers (Francis & Addom, 2014). Also, the extension officer-ratio is very high making the number of request extension officers do receive being greater they can serve. This contribute to officers rising their service charges since demand is high. Even the public extension officers demand fuel as their demand is being risen. All these

tend to make the cost of delivery very high. However, with the high level of education on the importance of extension service, farmers are able to put themselves into groups and seek the assistance of an extension officer to help (Devkota et al., 2016).

2.14.2.4 High Extension – Farmer Ratio

The cutting of budget leads to the training of inadequate extension officers, inadequate means of transport, and other logistics. Devkota et al. (2016) Said the extension officer – farmer high ratio is caused by the freezing of public sector employment raising the ratio to 1:1000 when it was supposed to be1:400 (Devkota et al., 2016). This created a space since there is no effective private sector to fill such a gap (Francis & Addom, 2014).

2.14.2.5 Weak Institutions and Inadequate Logistics

The institutions mandated to carry agricultural extension services are neither empowered nor resourced enough to do their work. Most of them are without the right logistics to carry out their duties. Some resort to the use of their personal items like means of transport and working aid to serve their clients. This inadequate availability of logistics limits the movement and operation of some officers making them not able to attend to the needs of farmers within their catchment area. Another challenge some officers faced is poor road network. There are certain areas with bad roads preventing extension officers to serve their farmers at certain periods especially during rainy season. Agricultural Extension Services over the years showed that the most difficult challenge is mobility and access to information (Devkota et al., 2016).

2.15 Review of methodologies

The Probability choice models used in this research has been used severally by early studies. It is used on willingness to pay, technology adoption studies, and choice of technologies.

The Multivariate Probit Analysis was used by Fernandez (2017) to determine adoption of erosion management practices in New Zealand while Trinh, et al. (2018) also it used to examine the determinants of farmers' adaptation to climate change in agricultural production in the central region of Vietnam and discovered training attendance, farm size, damage level, educational level, farming experience, access to credit, and gender as the most influencing factors. Additionally, Ward et al., (2018) used it to examined Early adoption of conservation agriculture practices. Others like Meraner et al., 2015 used the model to identify determinants of farm diversification in the Netherlands. In the area of agricultural extension, Mittal and Mehar (2016) used the model to analyse the adoption of modern information and communication technology by farmers in India. Damisa and Igonoh (2007) and Ragasa et al., (2013) used it to analyse the adoption of integrated soil fertility management practices, and gender differences in access to extension services respectively.

Moreover, multinomial endogenous switching regression Kassie et al (2015) to analysed Production risks and food security under alternative technology choices in Malawi. Oparinde, (2021) also used it to examine Fish farmers' welfare and climate change adaptation strategies in southwest, Nigeria. Wage changes through job mobility in Europe was also analysed by Pérez & Sanz (2005) using the same model.

On the side of Kendall coefficient of concordance, Franceschini, & Maisano, (2021) used to analysed Aggregating multiple ordinal rankings in engineering design: Ubani, & Ononuju, (2013) carried out a study on "A study of failure and abandonment of public sector-driven civil engineering projects in Nigeria": using this model.

CHAPTER THREE

METHODOLOGY

3.1 Introduction

This chapter contains the methodology of the study consisting of the profile of the research area, techniques and procedures of the study, description of research design, data requirement of the study and sampling procedures of collecting data as well as mode of data analysis.

3.2 Profile of the Study Area

3.2.1 Location and Size

Upper West Region is located in the North-Western part of Ghana. To it south boundary is savannah region, Eastern side is Upper East and North-East Region and Burkina Faso is in the North and Western side. It is laying between longitudes 1°25'W and 2°50'W, and between latitudes 9°35N and 11°N. The region is occupying 18,476 sq. km of land area which is 12.7% of Ghana's total land area (Tette et al., 2020).

3.2.2 Topography and Drainage

Upper West Region is part of the high plains which stretches geographically to North-Western side of Ghana. It is characterised with a wide range of plateaus consisting of Birrimiam and post-Birrimiam granites and their weathered materials. With occasional granitic outcrops rising above them. It has varying altitudes between 200m to 350m for the ridge which stretches from Wa located south of Burkina Faso border in the North that forms the basin between the Black Volta in the west and the Kulkpawn River and the White Volta in the east, with heights ranging from 200 m (Black Volta) to 350m.

Upper West Region has well-drained soils both at high and low elevations. The highest point in the area is Kaleo Hill (north of Wa), a 435-meter-tall granite cone. Several bodies of water flow through the area. The Black Volta and Kulkpawn Rivers, which run through the western and eastern ends of the region, are two important rivers (Abu & Buah, 2011).

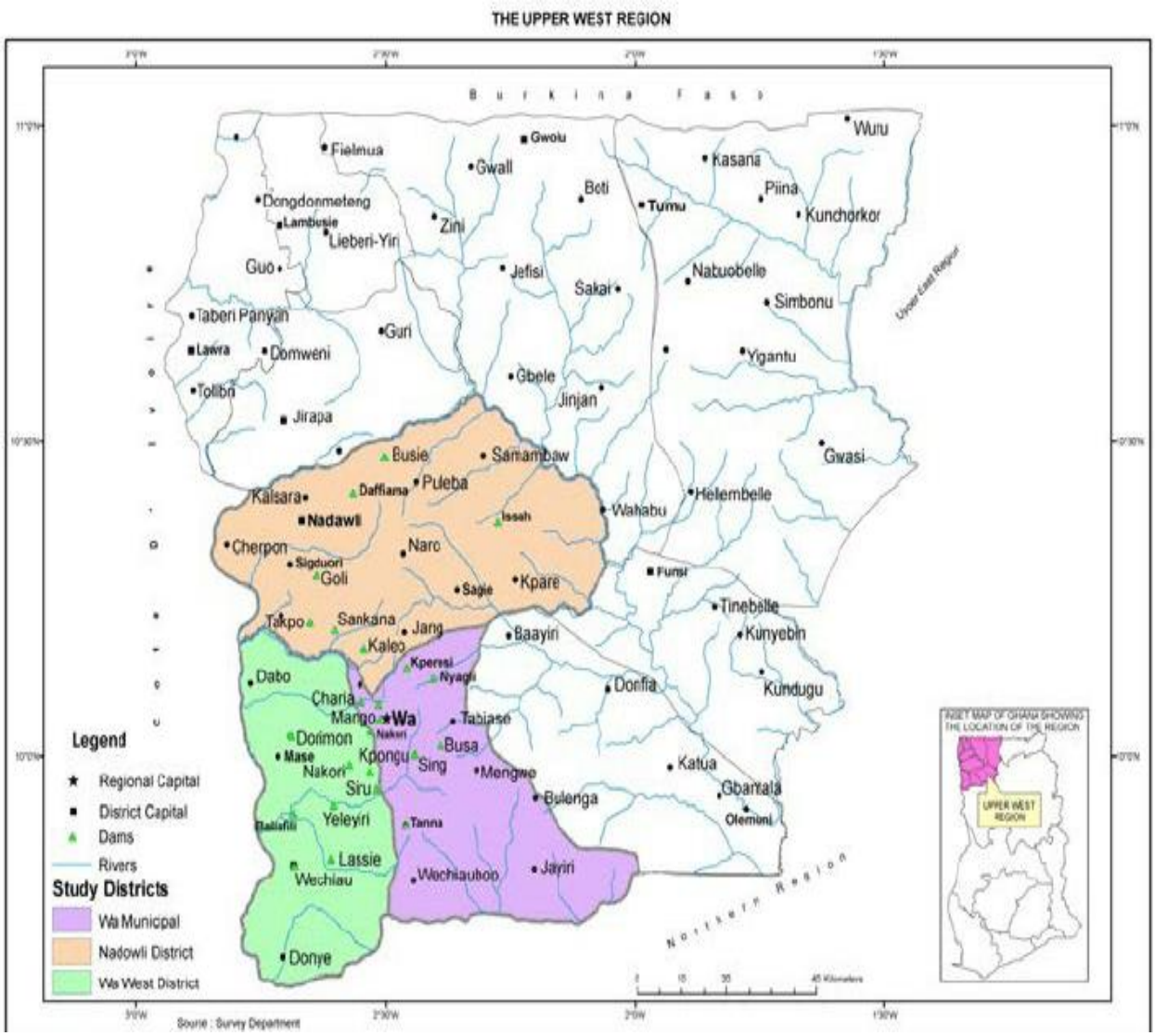

Figure 3.1 Showing map of study area

Source: Ali, et al, (2022).

3.2.3 Geology and Soils

According to reconnaissance survey the soil of Upper West Region constituent basic rocks, Birrimian rocks, post- Birrimian granites and mixed recent alluvium (Salifu M. et al 2017). The alluviams are located around the black volta floodplain including the other major rivers and falls under the Bala-Yipiani Association. Coarse sand is mostly seen around a series of this associations closed to river levees. Some are also found around the floodplain but that one is poorly drained, greyish brown fine sandy clay or silty clay barns. According to FAO classification, they are closely flood Fluvisols, Arenosols or Gleysols. The black volta floodolain is surrounded by Birrimian rocks and stretched eastwards in large strip from Wechiau in the south to the north and are members of the Wenchi-Pale Association. This association type of soil is always found in a top sequence but different from those with very shallow sandy loam having medium and coarse quartz stones and iron pan boulders on the surface (Dystric Leptosol) to those lying deep but poorly drained alluvial clays (Vertic Cambisol) in valley bottoms.

Greaater part of the other area soil formed over post-Birrimian granites and the associated basic rocks which fall under Verempere-Kupela (widespread, covering 65% of the region) and Deri-Pani Associations. The granite gave birth to the Verempere-Kupela Association with it major soil being moderately deep, well drained, reddish yellow sandy boaxus to sandy barns and occupy relatively flat summits, upper and middle slopes. Other types occupying flat valleys are deep, poorly drained, dark grey salty clay loam. The FAO classification system said the soils are estimated to be Lixisols, Vertisols, Fluvisols or Gleysols. A series of granites and basic rocks forms the

Deri-Pani Association which also occupy top sequence and vary from shallow and gravelly soils (Leptosols) on undulating terrains to deep, greyish brown alluvial clay in wide bottom lands.

3.2.4 Climate

The Upper West Region's climate is exclusively a single-peak rainfall regime and a very long period dry season that lasts from October to the end of April. Zone Aw of Koeppen's classification (tropical rainy climate with a distinct dry season), forms the southern part of the region. Whereby the northern part is Bs (dry climate with annual evaporation exceeding annual precipitation). The location of the region made the rainfall pattern to be how it is since the region is found in the sub-equatorial zone with changing wind regimes in the course of the year. The area is under the influence of the north-eastern trade- wind (Harmattan) when it is dry season which makes it relative humidity drop to a minimum of 16% in January (Wa). Maritime air from the south western monsoon and strong convection brings high rainfall during the rainy season with relative humidity rising to 69% in August (Wa). It has it rain fall being between 900mm (Tumu) in the north to 1,111mm (Wa) in the south. There is a variation in it total rainfall and the distribution of the rain in different years. When the rain fall starts in April and May, it is followed by dry spell of three to five weeks causing serious crop damage. Wa annual mean temperature is about 27.2°C with 35.5°C as it maximum and 18.8°C minimum.

3.2.5 Vegetation

The Upper West Region has the guinea savanna zone and the sudan savanna zone in the south and north and northeast respectively term as two agro-ecological zone. This

subdivision of the region influenced the rainfall pattern. Half –way between Jirapa and Nadowli is the boundary between the two zones.

There are scattered trees and a scanty grass ground cover, Baobab (Adansoniadigitata), dawadawa (Parkiaclappertoniana), shea (Butyrospermumparadoxumsubsp. parkii), Acacia albida, and Albixxia species in the Sudan savanna

3.2.6 Environmental Situation

Bush burning, tree felling for firewood, sand and gravel mining, are the major human activities in the region until recently small-scale mining comes to join them degrading both the vegetation and ecosystem. Most farmers in the region uses methods such as slash and burn, shifting cultivation in cultivating the land. They are found of also farming along streams, river banks and some other water bodies. The human activities caused depletion of the vegetation, soil erosion, loss of soil fertility, desertification, and species extinction (Atuoye, et al., 2017).

The construction of roads, dams and buildings leads to land deterioration. Urbanization, open grazing, expansion of towns and creation of new towns deplete the natural environment (Ampofo, 2020).

3.2.7 Land use

It is projected that around 70% (12,933.2 sq. km) of the total land area of 18,476 sq. km is arable. However, the overall fertility of the ground remains uncertain, with farmers requiring significant amounts of fertiliser to achieve adequate crop production. Aside

from agriculture, other uses of land include forest reserves, urbanisation, and, more recently, mining. Land is traditionally controlled by families, the leadership of which grants land under varied terms for development reasons (Nara, et al., 2014; Biitir & Kuusaana, 2019).

3.2.8 Demography

The current population and housing census carried out 2021 pegged Upper West Region population at 901,502. The region moved from being the second to last populated region to sixth position with the number of regions being increased to sixteen by the current government in power. Among the eleven districts in the Upper West Region, Wa Municipal recorded the largest population size, 200,672 22.3 %) out of the region total population. Sissala West recorded 63,828 (7.1%), Sissala East recorded 80,619 (8.9%) and Wa East 91,457 population share (10.1%) (Mehta et al., 2021). According to the results of the 2021 Population and Housing Census, the population of the region is made up of 461,185 females (51.2%) and 440,317 males (48.8%).

3.2.9 Ethnicity and Religion

There are different ethnic groups in the region with diverse cultures and languages showing their identity. The voltaic branch of the Niger- Congo language or the Gur family languages are spoken by most of these ethnic groups (Poorthius, 2018). They have links and have been intermarrying resulting in most of them belonging to the Mole – Dagbani group. The major ethnic groups are the Waala, Dagaaba, Sissala, Chakali and Lobi. There are other smaller ethnic groups like the Hausa, Fulani, and Moshie who are settlers from neighbouring countries.

Most of the major ethnic groups practised patrilineal system of inheritance. The most predominant religious groups are Christianity, Islam and Africa Traditional Religion. Traditional life and beliefs are more prominent in the rural areas.

3.2.10 Major economic activities

Over 80% of the people in the region engaged in agriculture either directly or indirectly (production and processing). However, there are other economic activities such as trading, mining, weaving, basket weaving, traditional textile manufacturing, and fishing

Table 3.1 Location of other Office Branches

OFFICE BRANCH (Agriculture Development Units)	LOCATION
Wa Municipal	Wa
Wa East	Funsi
Wa West	Wechiau
Nadowli / Kaleo	Nadowli
Jirapa	Jirapa
Lawra	Lawra
Lambussie – Karni	Lambussie
Sissala – East	Tumu
Sissala – West	Gwollu
Babile Pig Breeding Station	Babile
Babile	Babile

Source: Field Survey, 2021

Over one – third of gross domestic product is contributed by agriculture and it is the leading economic activity in the region for so many years. Many of the farmers engaged in the cultivation of food crops such as millet, sorghum and maize; roots and tubers, particularly yams, groundnuts and beans. They also rear animals like cattle and ruminants but over 90 percent (91.4%) of the farmers in the region are in rural areas. With the exception of Wa Municipal which is a little more than half (52.9%) of the agricultural households in the rural areas, there are similarities with the rest of the urban and rural areas in the region. The region agricultural households' size of 10 or more is one – fifth which forms 20.4% of the agricultural households in the region. Meanwhile Wa Municipal alone forms 27.2% of that population. So the conclusion is that, agricultural households in Upper West Region have large size with its average size being 6.9 persons.

3.2.11 Agricultural Households by Locality and Sex

In Upper West Region 77% of agricultural households are in urban centres and male – headed households out of the 80.8% of the rural population engaged in agriculture (Adu et al, 2018). The number of male-headed agricultural households is three times more than that is headed by female in all the districts except Sissala East (69.3%).

3.2.12 Types of crops households cultivate

Grains, roots, tubers, and legumes are the principal crops farmed in the Upper West area. Many of these families engage in mono-cropping (growing a single crop on a single plot), intercropping (growing multiple crops on the same plot), or crop rotation. In the region, around 84% of agroforestry families were located in rural regions. In rural

regions, the percentage of families planting beans and peanuts was 97.1% and 93.1%, respectively. Only 15.0% of carrot-growing households lived in cities.

3.3 Research Design

The research used a cross-sectional survey design in the conduct of its activities and is descriptive in nature and character. In order for the study to accomplish its objectives, the mixed methods strategies were applied through the integration of qualitative and quantitative research within a single research project (Kaplan, 2015). Mixed methods design according to Fetters et al. (2013) incorporates the collection and analysis of numerically, quantifiable and valued laden data in a singular study. It is established that the mixed methods approach is very much appropriate and employed in the study due to the inherent complementary nature of quantitative and qualitative data sets.

The mixed methods are used because the study involves a procedure for collecting and analysing both qualitative and quantitative data within the study in order to understand the research problem more completely (Fetters et al., 2013). The combination of qualitative and quantitative methodologies is advantageous especially when some of the objectives are better assessed using qualitative while others are assessed using quantitative methods. The use of mixed methods such as the descriptive analysis of survey data, in-depth interviews and participant observation formed the basis of a participatory method.

The quantitative data emphasis the use of deductive logic to arrive at conclusions. It highlights on objectivity, careful standardized measurement of variables, controlled

situations, statistical analysis, controlled of situation and the absence of the researcher's values in drawing conclusions. Quantitative data also assist the researcher to demonstrate the relationship between the independent and dependent variables.

The qualitative data seek to understand participants' experiences from the perspective of those who experienced them. It relies on inductive logic instead of deductive. Often large volumes of data are gathered or collected, analysed and then interpreted. Some common types of qualitative research which was considered in the study are unstructured systematic observation, ethnographic studies, cross-cultural research, case studies, grounded theory, oral histories, and feminist research. The study involved analysed and evaluated effects of agricultural extension information needs delivery on maize yield in the Upper West Region of Ghana.

3.4 Design of Survey Instruments

To detail out the strategies of the field instruments for the study, the experience gained during the desk study as well as the reconnaissance surveys was applied. The design of survey instruments manifest in formative (qualitative) and summative (quantitative) dimensions. The key variables of measure include factors that determine access to Agricultural Extension Information needs, effects of Agricultural Extension Information needs delivery on maize yield and constraints in accessing and delivering Agricultural Extension Information needs in the Upper West Region.

3.4.1 Field Work

Basically, three methods of data collection was adopted. These comprise focus group discussion, key informant interview, and household survey with the researcher's effective personal observation as an integral part of each. The detailed descriptions of the methods are as follows:

3.4.1.1 Focus Group Discussions

Focus Group Discussions constitutes one of fieldwork instruments in the assembly of qualitative data on the knowledge, usage and experiences with maize crop farmers wellbeing and livelihood strategies. It will enrich the gathering of data on the farmers' experience on access to information and knowledge of agricultural and their wellbeing. Such special group discussions specifically will be held with small holder farmers between 18 to 63 years. In all three (3) focus group discussions were held.

3.4.1.2 Key Informant Interviews

Interview with key informants using a checklist was adopted to gather the requisite information for the performance review. The aim of the interview is to solicit views to corroborate alternative information expressed by others or obtained from different sources through the use of other survey tools. The key informant interviews was following the focus group discussions and they are essentially on a "one-to-one" basis between the survey team and key informants.

3.5 Sampling Techniques

3.5.1 Sampling of Districts for study

When population is large and widely dispersed, the use of a simple random sample poses administrative problems. Purposive sampling is used when it is impossible or impractical to sample individual elements from the population as a whole or when there is no exhaustive list of elements from the list of all elements. In purposive sampling, there is a successive random selection of naturally occurring groups or areas and then selecting individual elements from the chosen group or areas. To select the districts for the study, the entire region was categorized into two clusters namely the urban districts (Wa Municipal, Nadowli/Kaleo, Jirapa and Lawra) and rural districts (Wa West, Wa East, Dafiama-Bussie-Issa, Nandom, Sissala West, Sissala East and Lambussie/Karni). This is to give representation to the different demographic characteristics among the various districts in the region and also cater for maize farmers or farmer's groups. The researcher then used Purposive sampling which is a form of non-probability sample to select the districts for the study. This means districts did not have equal chance to be selected. However, Babbie (2011) suggests that occasionally it is appropriate to select a sample on the basis of knowledge of a population, its elements, and the purpose of the study. Whilst studying a target sample of the population who are best suited to answer the research questions, the researcher may collect sufficient data from the respondents that address the issue the researcher is investigating (Babbie, 2011). In line with this background, the ability to contribute to the research objectives formed the basis of the purposive sampling in the study, hence the selection of three districts from the rural category for the study. Out of the eleven districts in the region, the study selected three

(3) districts which are the food basket of the Upper West Region, thus Wa East, Sissala West and Sissala East for the study.

3.5.2 Sampling of Communities and Respondents

To Vasuki (2021), the population of a study is the complete set group of individuals, whether that group comprises a nation or a group of people with a common characteristic. The population of the study comprises maize farmers which includes both males and females. Simple random sampling was used to select both communities and respondents which mean all the communities and maize farmers in the study districts have equal chances of being selected. Simple random sampling was used to make statistical inferences about the communities and population in the study districts. It will help to ensure high internal and external validity and reduce the impact of potential confounding variables. With simple random sampling, a random number generator or number table was used; three communities were randomly selected to represent the numerous communities in the study area and the sample was randomly picked from those three communities to represent the characteristics of the larger population.

3.6 Population, Sampled Units and Size

The study population consists of maize farmers and agricultural extension officers. The researcher interviewed four hundred and thirty – six (436) maize farmers and twenty – five (25) Agricultural Extension Officers. As the region is notably agrarian, the study population comprised individuals who are deeply into agricultural activities in the selected communities of the Upper West Region. It also comprised of individuals who considered agriculture as their means of survival in the region.

Table 3.2 Distribution of households engaged in agricultural activities by type of locality and crop cultivated Number of persons engaged in agriculture

		Urban		Rural	
Type of crop	Total	Number	Percent	Number	Percent
Maize	901,502	238,284	26.4	663,218	73.6

Source: Field Survey, 2021

Slovin's (1960) sample size determination formula is used to determine the sample size under the condition that only households in the rural districts who produce maize were interviewed:

$$n = \frac{N}{[1+Ne^2]} \qquad (1)$$

Where n = Sample size, N = Sampled frame = 663218 and e = Sample error/Significant level = 5% = 0.05, n = 663281/ (1+663218 x 0.05^2) = 399.76 = 400

Table 3.3 Distribution of Respondents (Extension Officers)

DISTRICT	EXTENSION OFFICERS
Wa Municipal	4
Wa West	2
Wa East	3
Sissala West	2
Sissala East	2
Lawra	2
Jirapa	2
Nadowli / Kaleo	2
Nandom	2
Daffiama / Busie / Issa	2
Lambusie / Karni	2
Total	25

Source: Field Survey, 2021

Table 3.4 Distribution of Respondents (Maize farmers)

District	Maize Farmers
Wa East	146
Sissala East	145
Sissala West	145
Total	436

Source: Field Survey, 2021

3.7 Validity of the Instruments

Validity of a research instrument examine the accuracy of the instrument in evaluating what it is designed to evaluate (Kikkert et al., 2011). It measures the extend of its accuracy. Validity is simple the act of examining the goodness of an instrument to perform it function accurately in terms of the quality of work. In research, interview guides are used to ensure the accuracy of the questionnaire. The interview guides are pretested to examine the suitability in measuring the variables which are factors determining access to agricultural extension information needs, effects of agricultural extension information need delivery on maize yield and the constraints maize farmers faced in accessing as well as those extension officers also faced in delivering agricultural extension information in the Upper West Region.

3.8 Reliability of Instruments

Alon and Nachmias (2020) note that reliability is an indication of the extent to which a measure contains variable errors, that is errors that differ from observation and that vary from time to time for a given unit of analysis measured twice or more by the same instrument. Abrahamson (2016) contends that reliability is the stability or consistency of the information, the extent to which the same information is supplied when a measurement is performed more than once. In order to check for the stability, consistency, accuracy and dependability, the instruments and techniques of data collection were pretested to establish the extent to which they can consistently measure what they are designed to measure. Areas of concern that needs clarity was revised in line with results of the pre-test.

3.9 Data Analysis

Data analysis of the questionnaires in this study aimed at reducing masses of quantitative data to meaningful information. Data was coded and a data matrix created using the SPSS computer package version 20. Variables were categorized and measured in accordance to the objectives of the study. Multivariate probit model was employed to analyse objective one, Multinomial endogenous treatment effects regression is used to analyse objective two of the research, Garrett ranking approach is used to analysed objective three. The emphasis here was to measure relationships among variables contained in the study so as to establish their degree of dependence and interdependence.

Qualitative data is organized according to the emerging themes. Variables attributes are described and normative aspect of districts is explained in accordance to the emerging themes from the data gathered. Data is presented in frequency distributions and diagrams; mainly graphs and tables.

3.10 Theoretical Framework

3.10.1 Multivariate Probit Model

The objective one (determinants of agricultural extension needs of maize farmers) is analysed using a multivariate probit model which is mainly used to analyse discrete choices made by individuals recorded in a survey data. It is used to estimate several correlated outcomes jointly. In other words, it is a product of simultaneously solving more than one univariate probit models whose dependent variables are assumed to be correlated.

The rational for using the model are two. First, the choice of any agricultural extension information need is dichotomous in the sense that a maize farmer may decide to select it or not. In making these choices maize farmers may decide to choose production information or post-harvest information or marketing information. It is also believed some of these choices are made based on the same reason or reasons. Secondly the choice of an agricultural extension information need can be more than one. Farmers for reasons known to themselves prefer multiple agricultural extension need. The general specification for the MVP is given as;

$$Y_{ik}^{*} = \beta_k X_{ik} + \alpha_k A_{ik} + \varepsilon_k \quad (2)$$

$$\begin{Bmatrix} Y_{ik} = 1 \; if \; Y_{ik}^{*} > 0 \\ Y_{ik} = 0 \; if \; otherwise \end{Bmatrix} \quad (3)$$

$$\varepsilon_i = [\varepsilon_{i1}, \varepsilon_{i2}, \dots \dots \dots \varepsilon_{iM}] \sim MVN(0, R) \quad (4)$$

"MVN" denotes the multivariate normal distribution. The R is the correlation matrix between the various dependent variables (Mittal & Mehar, 2016).

3.10.2 Multinomial Endogenous Treatment Model

Multinomial endogenous treatment regression is used to analysed objective two (effect of agricultural extension needs on maize yield). Deb & Trivedi (2006) are the originators

of the model. The main reason for using this model is to account for selection bias arising from observable and unobservable factors. In this model, we conceptualized that the adoption decision for alternative agricultural extension information need is modelled in a random utility framework. In the adoption selection model, we assumed maize farmers have an objective of maximizing their profit by comparing the profit obtained from different agricultural extension information accessed.

It is also used to estimate the relationship between outcome variables and a set of explanatory variables for each selected agricultural extension information need. The model involves two steps which leads to two equations called treatment effect equation and outcome equation (Luh et al., 2022; Munkin & Trivedi, 2008).

Stage one: farmers' choices of individual and combined agricultural extension information (production, marketing, postharvest-storage) they need are modelled using a multinomial logit selection model while accounting for unobserved heterogeneity since the extension needs variable is categorical. This forms the treatment effect equation. Those who did not access extension services are used as the based category

Following from the originators of the model, Deb and Trivedi (2006), the study hypothesized a mixed multinomial logit (MMLM) model showing the probability of a farmer accessing any of the extension needs

$$Y_{ij}^{*} = \alpha_j Z_j + \sum_{k=1}^{J} \delta_{jk} l_{ik} + \eta_{ij} \qquad (5)$$

$\boldsymbol{Y_{ij}^{*}}$ is a latent variable that incorporates the expected maize yield resulting from their access to the extension needs; $\boldsymbol{Z_j}$ is the vector of observed exogenous explanatory variables that explain the decision to access extension for any of the extension needs. Access to extension for any of the three purposes is suspected to be endogenous; $\boldsymbol{l_{ik}}$ is the latent factor that deals with the unobserved characteristics of farmers that simultaneously influences the outcome (maize yield) and the access to extension for any of the needs; $\boldsymbol{\eta_{ij}}$ represent the error terms which are independently and identically distributed; $\boldsymbol{\alpha_j}$ and $\boldsymbol{\delta_{jk}}$ represent coefficients to be estimated

Second stage; the effects of the farmers' choice of individual and combined agricultural extension information they have accessed on their maize yield are examined using ordinary least squares (OLS) with selectivity correction terms. The expected outcome equation is given as;

- $$E\left(y_i \mid \mathrm{d_i}, x_i, l_i\right) = \beta x_i + \sum_{j=1}^{J} \gamma_j d_{ij} + \sum_{j=1}^{J} \lambda_j l_{ij} \qquad (6)$$

y_i represent maize yield.

x_i represents the exogenous explanatory variables

γ_j measures the effects of extension needs (treatments) on maize yield relative to those who did not access extension service (the base treatment)

l_{ij} is the latent factor and Lambda (λ_j) is the factor loading parameter, which measures the correlation between the treatment and the outcome through the unobserved characteristics (+/-)

When it is significant, it means the endogeneity problem has been corrected by the model

Independent variables in the treatment effects equation can be used in the outcome equation but that of the outcome equation cannot be used in the treatment effects equation.

3.10.3 Kendall's Coefficient of Concordance

Objective three (challenges of agricultural extension delivery and access) is analysed using Kendall's Coefficient of Concordance. It is a non-parametric statistical method used to measure agreement among raters. The statistic ranges between zero (0) and one (1). Where zero means no agreement among the raters and one means total agreement among raters. Numbers between zero and one shows some degree of agreement among raters (Gearhart et al., 2013).

Kendall's coefficient of concordance is used to rank the challenges of the extension delivery services and access. It is expressed as;

$$W = \frac{12S}{p^2(n^3 - n) - pT} \qquad (7)$$

S is the sum-of-squares from row sums of ranks R_i, n is the number of objects, p is the number of judges and T is a correction factor for tied ranks (Chike, et al 2014).

$$T = \sum_{k=1}^{m} \left(t_k^3 - t_k\right) \tag{8}$$

$$S' = \sum_{i=1}^{n} R_i^2 = SSR \tag{9}$$

t_k is the number of tied ranks in each (k) of m groups (Chike, et al, 2014)

CHAPTER FOUR

RESULTS AND DISCUSSION

4.1 Introduction

This chapter presents an analysis on the effects of agricultural information needs delivery on maize yields in the Upper West Region. The analysis discusses the characteristics of the selected districts and the socio-economic characteristics of the farmers. Again, the analysis discusses the factors that determine access to extension services amongst maize farmers', the effects of agricultural extension information need delivery on maize yield and constraints maize farmers faced in accessing as well as those extension officers faced in delivering agricultural extension information in the Upper West Region.

4.2 Socio-economic Characteristics of Respondents

As a section devoted for socio-economic characteristics, it discusses analysis regarding the social and economic features of the respondents (maize farmers). Key among the variables discussed under this include the age, sex, household size, household head, educational level of respondents, farm size of farmers, access to credit, access to market, years in farming, number of dependents, other forms of occupation aside farming and average monthly income of respondents.

Sex distribution of respondents was involved in order to answer the questionnaires supplied as shown on Table 4.1.

Table 4.1 Showing sex distribution of respondents

Respondents	Frequency	Percentage
Male	262	60
Female	174	40
Total	**436**	**100.0**

Source: Field Survey, 2021

Table 4.1 shows that 60% of the respondents were males and 40% were females who respectively answered the questionnaires distributed. This implies that majority of the respondents at the study area were male farmers. By implication, the study setting has more farmers who are not so much engaged with other important things like family chores or may one-time be indisposed by becoming pregnant or giving birth but will have almost all the time at their disposal to utilize the agricultural information needs and extension services compared to their female counterparts. The study found that middle aged farmers are seen to be more risk taking with longer planning horizon than the older people.

Probably, the reason for the large number of respondents being male farmers could be attributed to the fact that male farmers form a chunk of the household heads and also respondents for household heads that are absent during the administration of questionnaire. Meanwhile Norton & Alwang (2020) found that gender plays a tremendous role in attaining production resources and that of information utilization. Women were hugely considered as an invincible workforce and therefore the backbone of the family and economy. The study agreed that women activities are stifled with

restrictions emanating from socio-cultural frameworks. Restrictions of such nature limit their ability in accumulating assets and that of production resources hence affecting their demand and supply to improving productive practices. In the same vein, women are barely allocated land for the purpose of agriculture and therefore have unequal access to necessary productive resources including agricultural extension information compared to their male counterparts. This can lead to differentials in seeking and acquiring information utilization between the two sexes as smallholder farmers.

Alternatively, it could be that one sided family labour is predominant in the study area by the smallholder farmers. This results from the cultural dynamics of the people and that of the subsistence farm households which are poor in resource control with no alternative but to depend on family labour for agricultural activities, this position is supported by (Asfar, 2011). Also, a positive and a significant relationship exist between size of family and utilization of information (Mohammed et al., 2018).

Table 4.2 and Table 4.3 below presents the descriptive statistics of the social and economic characteristics of the respondents.

Table 4.2 Age category of respondents

Age Distribution	Frequency	Percent
21-30	122	28%
31-40	196	45%
41-50	74	17%
Above 50	44	10%
Total	436	100.0

Source: Field Survey, 2021

Table 4.3 Descriptive Statistic of Socio-economic Characteristics of Respondents

	Mean	Standard Deviation	Minimum	Maximum	Covariance
Age	39.112	10.251	18.000	60.000	26%
Household size	9.872	5.531	4.000	38.000	56%
Income	282.144	232.348	40.000	1500.000	82%
Extension no.	2.284	1.069	1.000	5.000	47%
Farm size	5.218	2.474	1.000	12.000	47%
Yield(tons)	1.244	0.267	0.700	3.020	21%
Labour	3.213	1.455	1.200	7.200	45%
Machine hours	34.076	14.710	15.000	75.000	43%
Chemicals	1.690	3.962	0.000	24.000	234%
Fertilizer(kg)	712.4	303.6	250.000	1,500.000	43%
Seed(tons)	0.488	0.204	0.200	0.100	42%

Source: Field Survey, 2021

The study revealed in Table 4.2 that, the age category of 31-40 years constituted 45% of the respondents, followed by 21-30 years who were 28%. Meanwhile the age group of 41-50 recorded 17% whereas 50 and above was made up of 10% which is the lowest number of maize crop farmers in the study area. This implies that, the study area has the potential of increasing the maize yield since both employment rate and productivity level vary across population groups and study area has most of the sampled population falling within the youth brackets which is the active working group. Table 4.3 shows the average age of the farmer in the sample is 39.112 which is approximately 40 years. Farmers over the age of 60 were found to still be engaging in farming, while the youngest was 17 years old. The average of 40 years suggests the low level of participation of the youth in maize farming. Access to land has been the major challenge for youth in agriculture as compared to older and experienced farmers (Paredes et al., 2014). Invariably, this age range has the advantage of utilizing the needed extension service and agricultural information since most of the respondents falls within the youth brackets. The study has the chance of making use of any information that is imparted to them. The age of an individual has the likelihood of affecting his or her mental attitude to new ideas and could impact information application or utilization in varying degrees (Adekunle, 2013).

However, Asiabaka et al., (2010) postulated that, the ability of farmers to make use of agricultural information and that of novel innovations reduces with age of an individual. As farmers grow older, the less likely they will utilize information. Risks taking in this regard are more associated with the younger farmers than the older farmers.

Monthly income of farmers is about GH₵284 and GH₵360 for the farming season. Fertilizer usage revolved around an average of 712.4kg in the farming season as compared to the recommended 100kg per hectare. This could be attributed to many farmers who were losing their crops to the fall armyworms resorted to the use of more fertilizer to prevent the crops from withering away.

The household size which indicates an average of 10 people in the farming households in the region could be taken advantage of by encouraging cooperate farming. A maximum of 40 people in a household can be considered extreme, but in the context of the study area, these extremes are normally with farmers who are from the wealthy homes in the community.

The study in its quest to unearth the role of these variables related to the farmer and their environments established that, in terms of electricity access, an appreciable number of the farmers (34%) are without electricity. This mean that, they would find it difficult having access to communication channels that require direct or indirect used of electricity. The study also revealed that 51% of the farmers have access to credit to support their farming activities. This means that, with the single maxima rainfall pattern in the region, the substantial number of the people in the study area would be unemployed for most part of the year when it is not raining. This could explain the high poverty rate in the region compared to other regions in Ghana. The use of pesticides was not encouraging as about 29% of the farmers employed the services of pesticides on their farms. This is because in a normal season, farmers do control another pest, but the outbreak of fall armyworm meant more was needed to control them. The used of

improved seeds among farmers in the region has been high (Ragasa et al., 2014). The sample confirmed 77% used improved seed in their farming activities compared to 23% who do not use improved seeds on their farms. This means that irrespective of the armyworm situation, a little over 70% of the farmers still used improved maize seeds. This is shown in Table 4.4 below

Table 4.4 Descriptive statistics of other variables

	Frequency	**Percentage**
Electricity		
Yes	287	66%
No	149	34%
FBO		
Yes	268	61%
No	168	39%
Armyworm		
Yes	128	29%
No	308	71%
Credit		
Yes	224	51%
No	212	49%
PFJ		
Yes	241	55%
No	195	45%
Improved Seed		
Yes	336	77%
No	100	23%

Source: Field Survey, 2021

Out of a total of four hundred and thirty-six (436) respondents 8% of them had (tertiary) college or undergraduate education, 26% of them had secondary education, 11% had junior high school education, 11% also had primary education with 44% of the respondents obtaining none in the education sector. This established that, majority of the respondents had no formal education among maize crop farmers. With 44% of the respondents obtaining none in education implies that a lot of respondents in the community will not have knowledge regarding extension services more particularly their impact on maize yield in the Upper West Region of the country. When people are educated, they are capable of making use of any extension service and the needed agricultural information to boost crop yields and increase smallholder farmer welfare or to be food secured.

Figure 4.1 shows marital status of respondents by the maize crop farmers in the study catchment area.

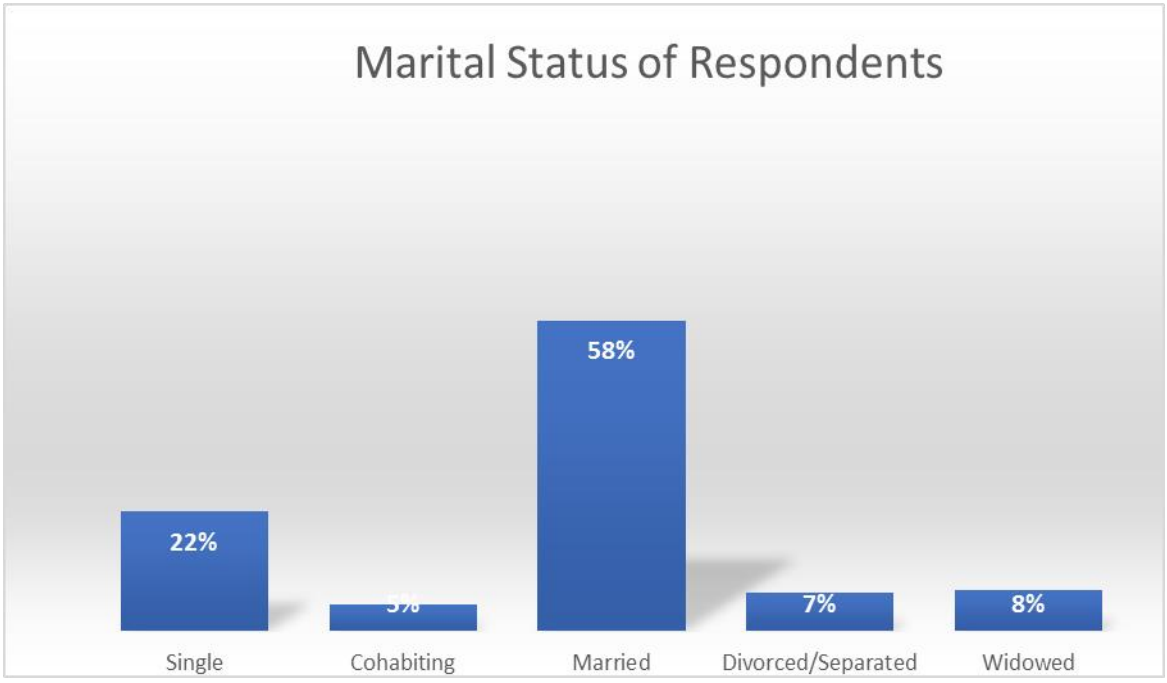

Figure 4.1 Showing marital status of respondents

Source: Field Survey, 2021

With regards to marital status of respondents, the above figure 4.1 indicated that 58% were married with the remaining 42% respondents were single, cohabiting, divorced/separated or widowed. The research findings show majority of the respondents which constitute 58% were married and have a fair idea of agricultural information needs and that of extension services. Married couples create a sense of awareness on the need to increase maize yields as a way of eliminating hunger and poverty from smallholder farmers.

4.3 Extension needs

Table 4.5 summarises the needs for which interviewed farmer sought extension services in the study area. It can be observed that, out the 436 farmers interviewed about 67% of them sought extension services for the purposes of production. This includes planting, fertilizer application, chemical application etc. Abugu et al. (2013) have confirmed this as most farmers' information needs was found to centre on production.

Table 4.5 Extension needs

Extension Needs	Frequency	Percentage
Production	293	67%
Marketing	208	48%
Postharvest-storage	224	51%

Source: Field Survey, 2021

Postharvest-storage constitutes the second highest extension needs of farmers. About 51% of the farmers sought information on postharvest and storage of their produce. Farmers in the northern Ghana in particular are subsistent (Bawa, 2019). This implies that they are interested on how to manage postharvest and storage for the output to last longer to feed the family all year round. It is for this same reason that the marketing information need is the lowest. Not many farmers are interested in selling their produce after harvest and would naturally not seek information on it

4.4 Factors that Determine Farmers Access to Extension Services Needs

This portion of the study is the objective one which sought to identify factors that determine access to agricultural extension information among maize farmers. Table 4.6 looked at the determinants of access to extension needs with emphasis on production, marketing and postharvest-storage. Within the model, the explanatory variables include gender, age, age squared, marital status, educational status, household size, household head, planting for food and jobs, membership of farmer-based organization, farm size, farm age, farm aged squared, average monthly income and frequency of accessing extension services.

Table 4.6 Determinants of Access to Extension Needs

	PRODUCTION		MARKETTING		POSTHARVEST-STORAGE	
Determinants	**Coef.**	**Std.Err.**	**Coef.**	**Std.Err.**	**Coef.**	**Std.Err.**
Sex	0.377**	0.154	-0.041	0.135	0.384***	0.13
Age	0.019*	0.011	0.001	0.01	0.008	0.009
Marital Status	0.148	0.283	0.092	0.248	0.259	0.23
Education	0.599***	0.192	0.545***	0.173	0.445**	0.184
Household head	0.581***	0.197	-0.316*	0.175	0.780***	0.18
Off farm	-0.500***	0.158	-0.473***	0.134	-0.324**	0.133
Household size	-0.048***	0.017	-0.019	0.015	-0.033**	0.015
Income	0.09	0.117	0.347***	0.105	0.016	0.097
Extension no.	0.450***	0.073	0.014	0.062	0.282***	0.061
Source of extension	0.156	0.155	-0.039	0.134	0.106	0.136
Electricity	-0.155	0.157	0.142	0.133	-0.178	0.139
FBO	0.12	0.156	-0.028	0.133	0.081	0.134
Armyworm	0.195	0.166	0.093	0.146	0.225*	0.14
Farm size	-0.016	0.03	0.027	0.026	-0.017	0.026
Credit	0.203	0.148	-0.111	0.13	0.121	0.125
PFJ	0.227	0.149	-0.284**	0.128	0.207*	0.124
Constant	-1.915***	0.722	-2.127***	0.611	-1.509**	0.602

Source: Author's computation based on field Survey, 2021

Based on the estimates, it revealed that the explanatory variables that were significant and satisfied the a priori expectations are farm size, educational status of the respondents, ownership of land for maize farming, farm age, farm age squared, number of years of farming, household size and occupation besides farming.

The coefficient of the sex variable is significant at 5% and 1% for production needs and postharvest-storage needs. This means that compared to women, men are more likely seek extension services for the purposes of production and how to store their output. It is not significant for marketing need even though the coefficient is negative, indicating that men are less likely to seek extension information on marketing. Traditionally, marketing of produce has been the preserve of women, even though the man will eventually take the income after the sale since they have more control on the farm produce (Trauger et al, 2010).

At 10%, age of farmer was found to be significant for only production needs. This means that as farmers grow old, they are more likely to be seeking extension information for the purposes of production. Findings also showed that farmers level of education was significant at 1% and has a positive effect on the probability of farmer's desire to take part in extension services suggesting that farmers with high level of education are more likely to comprehend the relevance of extension services and are more likely to incur cost in obtaining them than their counterpart with less educational level. It is found that educated farmer see the need to seek extension information for all categories of needs. In this case, educated people are more likely to access extension information for production, marketing and for postharvest-storage purposes. The result is consistent

with earlier studies conducted by Norton & Alwang (2020) but contradicts that of Aker (2016) in the agricultural crop sector within Ghana who found a negative association between farmer's access to extension services and educational attainment. Again, the study contradicts studies conducted by Davis et al. (2019), who suggested that those farmers with better level of education have the potential to manage their farms very well and are exposed to several management risk practices that can plunge the household into food crisis and are therefore less likely to participate in extension services.

The household headship of the farmer influences them to seek extension information on production and postharvest-storage, at 1% and 5% respectively. These heads are normally responsible for the food needs of the household and would make sure they harvest enough food as well as store it for all year-round consumption by the household. However, it can be seen that they are less likely to seek information on marketing since they are not interested in selling output but rather feed their household as subsistent farmers.

Farmers who engage in off farm activities are less likely to seek any of the extension information needs. The results are significant at 1%, 1% and 5% for production, marketing and postharvest-storage respectively. It is known that these farmers would have other issues to attend as far as the off-farm engagement is concern and would therefore not be interested in any extension information that would boost production on the farm. This finding is consistent with Tesema (2022) but contradicts Anang, Bäckman et al. (2020).

Farmers with larger household size are less likely to seek extension services for production and postharvest-storage reasons. Rich farmers tend to seek extension information on marketing. The finding is significant at 1%. These farmers are more likely to be business minded who feel they have fair knowledge on production issues and are only interested in the marketing aspect of the farming. Farmers who receive more extension visits are more likely to seek all the extension information needs, except marketing information. This gives an indication that extension service delivery in the study area is more tilted to production and storage to the detriment of marketing.

Armyworm infestation influences farmers to seek postharvest-storage extension service, which is significant at 10%. This finding does not meet a prior expectation since armyworm infestation is at the vegetative stage of maize production. The expectation is that farmers whose farms are infested with armyworm would seek extension information for production reasons not storage. Lastly, farmers participating in PFJ are less likely to seek marketing information and more likely to seek postharvest-storage extension information. This gives an indication that the program is paying less attention to the marketing aspect of maize production.

Since extension needs of farmers are many, the expectation is that farmers would seek varied information needs, which would lead to a correlation between these choices the farmers make. Table 4.7 summarizes the complementarity and substitutability of the various extension needs in a correlation matrix. A positive means the said extension needs are complementary, i.e., farmers are more likely to seek them together. A negative gives an indication that the said needs are substitutable. From the table, the rho of

production & marketing and that of production & postharvest-storage are positive and significant at 1%. This indicates that farmers who sought production information are more likely to seek marketing information, and also more likely to seek postharvest-storage information. This is understandable because each of the needs are premised on production need. For a farmer to pay more attention to the marketing of output, he /she might have paid equal attention to the production of the maize. The same goes for complementarity of production & postharvest-storage.

Table 4.7 Complementarity and substitutability of extension needs

Rho (Production & Mkt)	0.343***	**0.078**
Rho (Production & postharvest-storage)	0.841***	**0.035**
Rho (Mkt and postharvest-storage)	-0.120	0.082

Source: Author's computation based on field Survey, 2021

However, the relationship between marketing and postharvest-storage information needs is negative indicating they are substitutable. Even though this is expected, the rho is not statistically significant. It is very likely that when farmers seek information for storage and postharvest purposes, they are likely to keep their produce with them for some time, hence less likely to sell. Those seeking to sell, would probability need less information on storage, hence the negative sign.

4.5 The effects of extension services need on maize yield

As mentioned in the methodology, the Multinomial Endogenous Treatment Effect model consists of the treatment and the outcome models. The objective under

consideration is focusing on the results of the outcome model which measures the effect of the various extension needs on maize yield. The results of the treatment equation are found in the Appendix.

4.5.1 Extension needs categorization

For this model, the extension needs were categorised in order to be used in the outcome model. The various categorizations are, no extension, production only, marketing only, postharvest-storage only, production & marketing, production & postharvest-storage, marketing & postharvest-storage and all the three extension information. This is summarised in Table 4.8. It is shown that 23% of the sample had no access to extension services. Generally, many farmers in Ghana do not get access to extension due to several challenges, which includes a very high extension officer to farmer ratio, and accessibility (Antwi-Agyei & Stringer, 2021). The consequences of the higher percentage of farmers not having access to extension services is translated in low adoption rate of technologies, yield and welfare of farmers (Danso-Abbeam et al., 2018).

Table 4.8 Extension needs categorization

Extension Needs Categorization	Frequency	Percentages
No extension	99	23%
Production only	0	0%
Marketing only	44	10%
Postharvest-storage only	0	0%
Production & Marketing	69	16%
Production & postharvest-storage	129	30%
Marketing & Postharvest-storage	0	0%
All three	95	22%

Source: Field Survey, 2021

For production only, postharvest-storage only, and marketing & postharvest-storage, no farmer was found in those categories. According to Abukari et al. (2021), farmers' extension information need is multifaceted. It is therefore understandable that farmers hardly need one particular extension needs, hence the reason why no farmer was found to be interested in only production information or only postharvest-storage. It can be observed that extension need relating to production is dominant in Table 4.8 confirming what is in table 4.5 where production information is the most accessed need (67%) followed by postharvest-storage information with51%, indicating that farmers are more likely to combine production information needs with some other information needs but less likely to demand the extension services for production reasons only. But it is more likely for farmers not to demand marketing and post-harvest-storage information. On

this basis, no farmer was found to demand marketing and postharvest-storage storage information.

10% of the sampled farmer accessed only marketing information. Farming in Ghana especially the northern part has not been considered as a business (Abukari & Alemdar, 2019). However, very few farmers take the business side of it serious, thus 10%. These few farmers after harvesting would be interested in when to sell their produce for better prices as well as the market location to sell. This information they normally seek from the extension agents as well as other channels.

Farmers who accessed Production & marketing and production & postharvest-storage are 16% and 30% respectively of the total respondents. This high percentage is attributable to the higher information need on production. The production stage is generally the time information on farming practices, conditions of plants, pest and diseases etc. are sort from the extension agents. 22% of the farmers sought all the extension needs. This indicates that most farmers are not interested in all extension information needs, but rather selective on what they need.

4.5.2 The effects of extension services need on maize yield

The results of the effects of extension information needs on maize yield is recorded in Table 4.9 and 4.10. The results of the model appear to have fitted the data very well as the Wald Chi Squared of 414.03, which is significant at 1%, rejects the hypothesis that the regression coefficients are jointly correlated or equal to zero.

On the effects of the extension information needs on yield, it is found that, all categories of information needs that were accessed have a positive influence on maize yield except marketing only. This means farmers who are focused on only the business side of maize production do not care about the yield of the maize, hence the insignificant relationship. Ideally, farmers who are focussed on marketing information should as well be concerned about the production and postharvest information since output is directly a product of these information needs.

For farmers who sought extension information for the purposes of production & marketing, production & postharvest-storage, and all three categories, their yield increased with a statistical significance of 10% and 1%. This goes to confirm that extension information needs vary and a combination of them is needed to improve yield (Abukari et al., 2021).

What is also obvious is that farmers aside needing production information, it is also very vital in determining the yield of maize in the study area. It can be seen for all the three categories of information needs that improves yield. Production information is part of them unlike the other information needs. This finding emphasises the need for extension services in order to increase yield. Many studies have evaluated the effect of extension as a whole on productivity and the overwhelming finding is that extension access influence yield (Danso-Abbeam et al., 2018; Emmanuel et al., 2016; Abdallah & Abdul-Rahaman, 2016). However, this study goes beyond access to investigated the need for which the farmer had accessed the extension. The finding supports the results of the

above-mentioned references that extension positively influence yield, but goes further to reveal that a combination of production needs with others influences yield.

The traditional inputs and other factors known to influence production have been found to influence yield indifferent ways. All the traditional inputs of maize production (labour, machine hours, chemicals, fertilizer, etc.) except seed, have been found to positively influence yield. Labour as a very important factor of production execute all the activities needed in the production process and are expected to improve yield and output of the farm. This is especially when the labour employed is skilful at their job. A single additional skilled labour used on the farm is more likely to increase maize yield by 0.3.

Machine hours also positively influence yield, as an additional hour of machine usage on the farm increases maize yield by 0.1, and is significant at 10%. This gives an indication that the more mechanised the production process the higher the yield. This finding is in agreement with various studies across the world including the Ghanaian context such as Apiors et al. (2016) and Benin (2015).

The use of chemicals in the control of weed, pests and diseases also significantly increase maize yield by 0.1. This finding is supported by (Obour et al., 2022; Yangyuoru, et al., 2001). Even though there are concerns of overdosage by farmers and its implication on the output as well as the health of the farmer, chemical application improves the yield of crops by preventing weeds, pest, fungi, rodents and diseases in

general (Mattah et al. 2015). Osuman & Kugbe (2015) have also reviewed studies which indicates that, the timing of the chemical application is equally important as applying it.

Fertilizer application records the highest positive impact on maize among all the traditional maize production inputs. A kilogram addition of fertilizer on maize increases the yield by 0.8, which is statistically significant at 1%. Fertilizer could be organic or inorganic, and even though this study did not make this segregation, the positive effects of fertilizers on yield is common in many studies across all crops. In cases where the soils are highly degraded like most soils in the northern Ghana, fertilizer application does not become luxury but a must to improve the output of the field (Kanton et al., 2016; Adzawla et al., 2021; Essel et al., 2020). The importance of fertilizer to crop improvement has prompted governments in the past to always subsidise it for farmers in the farming season. It still remains the highly subsidised farm input under the government Planting for Food and Jobs.

Table 4.9 The effects of extension services need delivery on maize yield

Variables	Coef.	Std.Err.
Marketing only	0.106	0.466
Production & Marketing	0.776*	0.472
Production & postharvest-storage	1.979***	0.416
All three	1.667***	0.442
Labour	0.279**	0.138
Machine hours	0.069***	0.016
Chemicals	0.099***	0.03
Fertilizer	0.787***	0.194
Seed	-3.184***	0.588
Sex	0.279	0.235
Marital Status	0.23	0.398
Education	0.950***	0.31
Off farm	0.179	0.226
Household size	-0.049**	0.021
Improved seed	0.588**	0.254
Armyworm	-0.171	0.264
FBO	0.491**	0.229
Credit	0.440**	0.223
Age	0.018	0.013
PFJ	0.255	0.225
Constant	11.033***	0.645

Source: Field Survey, 2021

Seed is the only exception when it comes to the effect of traditional inputs on maize yield. Farmers normally used seed more than the recommended or waste a lot of it in the planting process (Adu et al., 2014). When farmers plant more than the recommended especially through broadcasting, plants do not get the appropriate distribution to grow. Furthermore, weed control also becomes difficult, which subsequently leads to low yield (Chim et al., 2012).

For the other control variables, education is found to have a positive effect and statistically significant at 1%. Educated farmers are assumed to be responsive to new farming practices that improves yield and welfare of farmers. Additionally, they are also more likely to adopt to new technologies and stand the better chance of accessing extension information through the internet, thereby increasing yield. The channel through which education affect maize yield is the investment of capital into the maize farm activities (Nyamekye et al., 2016). The larger the household of a farmer the lesser their maize yield. This effect can be explained from two stand points. Firstly, with access to agricultural lands becoming a challenge, more household size would mean less access to farm land, since household members would want to also farm on the limited lands. This will eventually lead to reduction in output. (Kwapong et al., 2021). Secondly, an individual with a lager household size, will have high expenditure which will make the farmer have less capital to invest into the farm to improve yield, hence lower yield (Danso-Abbeam et al., 2017).

Even though the quantity of seed used negatively influenced yield, when a farmer uses an improved seed, they are more likely to increase their yield by 0.6. The finding is

statistically significant at 5%. These varieties are normally improved to take care of challenges that local breeds face such as drought tolerance, pest tolerance, late maturing etc., making their usage advantageous by way of increasing yield. These results agree with that of Dokyiet al. (2021), Tweneboah Kodua et al. (2022) and Poku et al. (2018).

Finally, association with an FBO is found to improve maize yield. Association with these groups comes with its intended benefits to the farmer mostly through information and access to both inventory and non-inventory credit (Poku et al., 2018). Closely related is credit access which is also significant at 5%. Credit access enables the farmer to acquire the needed inputs at the right quantity and at the right time for production (Alhassan et al., 2020; Sekyi et al., 2017).

Table 4.10 illustrates a supplementary information about the results of the model in Table 4.9. The results depict the selectivity and endogeneity issues relating to the model. The Lambda is the factor loading parameter which measures the correlation between the treatment (determinants of extension needs) and the outcome (effects of extension needs on maize yield) through the unobserved characteristics. It could be positive or negative. When it is significant, it means the endogeneity problem has been corrected by the model.

Table 4.10: Endogeneity issues

	Coef.	Std.Err.
Lambda (Mkt only)	0.754**	0.328
Lambda (Production &Mkt)	0.898**	0.368
Lambda (Production & postharvest-storage)	-0.903**	0.348
Lambda (All three)	-0.596	0.377

Source: Field Survey, 2021

For all the four categories, only the categories where farmers use all the three information needs is not significant indicating the endogeneity problem associated with this category has not been solved meaning OLS will be inconsistent and biased. For the other three that are significant, thus marketing only and production & marketing are positive indicating that the endogeneity issue with this category has caused the treatment and the outcome to be correlated positively by the influence of unobserved characteristics, but the model has corrected it. Whiles the negative sign means the treatment and the outcome are inversely correlated through the unobserved characteristics, and the model has corrected it which implies the OLS is now free from inconsistency and biasness.

4.6 Challenges in accessing and delivering of extension services

4.6.1 Challenges in accessing extension services

This segment seeks to address objective three of the study which highlighted the challenges in accessing and delivering of extension services. The major constraints in the agricultural sector from current and past agricultural extension service delivery

include; nonexistence of national framework of agricultural extension policy that has been designed in a participatory manner, indistinct extension approach, absence of suitable adaptation of technology package to suit local conditions, inadequate budget allocation to extension system, constrain in the quality of technical and field staff, inadequate involvement of private sector service delivery, absence of monitoring and evaluation of the extension system, weak system of agricultural inputs distribution and supply systems, involvement of experts on duties other than extension responsibilities.

Table 4.11 Farmers extension access challenges

Challenges	Mean Rank	Rank
Availability	2.15	1
Not Regular	2.39	2
Distance to Source	2.43	3
Difficulty in Practicalizing Information	4.17	4
Inadequate Information	4.86	5
Understanding of Information	5	6
N	436	
Kendall's Wa	50%	
Chi-square	1088.587	
Df	5	
Asymp. Sig.	0	

Source: Field Survey, 2021

The use of extension services by farmers in the study area just like any other way of improving maize crop yield is not without barriers. This segment of the study assesses the challenges in accessing and delivering extension services among maize crop farmers. The result indicates that availability of extension service officers constitutes the major constraints with a mean rank of 2.15. This was followed by the irregular nature of extension services and distance to source with mean rank of 2.39 and 2.43 respectively as the main constraints facing the extension needs towards high yield production of maize crops. This lends credence to studies conducted by Birhanu et al. (2016) and Belay and Dawit (2017). that the main challenges of the current and past agricultural extension service delivery include; indistinct extension approach, inadequate extension officers, inconsistent or irregular nature of extension services, absence of suitable adaptation of technology package to local conditions, inadequate budget allocation to extension system, constrain in the quality of technical and field staff, inadequate involvement of private sector service delivery, absence of monitoring and evaluation of the extension system, week system of agricultural inputs distribution and supply systems, involvement of experts on duties other than extension responsibilities.

However, the concept of difficulty in practicalizing verbal information, inadequate information and understanding of information in accessing market information was not considered a much problem in their quest to increase yield of maize crops. As offered by the Kendall's coefficient of concordance value of 50% is significant to conclude that there was somewhat high agreement between the rankings of constraints by the farmers.

4.6.2 Challenges in delivering extension services

As contained in Table 4.12 below the study revealed that high extension farmer ratio with a mean rank of 2.68 is the major constraint faced by maize farmers in accessing agricultural extension information. Communication barriers also follows with a mean rank of 2.88 and next is cost involve in transportation with a mean rank of 3.20. They were seen to have been the constraints facing agricultural extension officers in the study area. Meanwhile, difficulty in meeting the farmers, issues regarding field allowance, cost of delivery, safety and amp, security does not pose much barrier to providing agricultural extension services by the extension officers.

Table 4.12 Challenges facing extension needs

Challenges	Mean Rank	Rank
High ext.-farmer ratio	2.68	1
Communication	2.88	2
Transportation	3.2	3
Safety & Security	3.92	4
Cost of delivery	4.24	5
Field allowances	5.36	6
Difficulty in meeting the farmers	5.72	7
N	25	
Kendall's Wa	30%	
Chi-Square	45.583	
Df	6	
Asymp. Sig.	0	

Source: Field Survey, 2021

The Kendall's coefficient of concordance value of 30% is significant and suggest a somewhat high agreement between the ranking of constraints by the farmers.

CHAPTER FIVE

SUMMARY, CONCLUSION AND RECOMMENDATIONS

5.1 Introduction

This is the final chapter of the study. It presents a summary of the key findings as well as the conclusions drawn and recommendations made to enhance maize farmers' access to agricultural extension information needs as well as their impacts on maize yield in the Upper West Region.

5.2 Summary

The research sought to study the effects of demand driven agricultural extension needs on maize yield in the Upper West Region of Ghana. Specifically, the research aimed at identifying the determinants of demand driven agricultural extension needs of maize farmers, assessing the effects of demand driven agricultural extension needs on maize yield and also examining the challenges of agricultural extension delivery and access in the Upper West Regions.

Three districts which are the food basket of Upper West Region were purposively selected whereas respondents and communities were randomly selected in each district. A total of 436 maize farmers and 25 agricultural extension officers were interviewed.

The mean age was about 40 years with majority of the maize farmers being males. About 44% of the respondents had no formal education whilst only 66% had access to electricity.

Amongst the reasons farmers sought extension services; market center information, pricing, fertilizer application, improved seed, weed control, sowing and storage were the most prominent.

The study identified three agricultural extension needs, production information, marketing information, and postharvest- storage information. The farmers' extension needs were found to be multiple in nature and complementary. The results of Table 4.3 shows farmers got an average visit of two in the whole production process of maize. Educated farmers are more likely to access all the three extension needs. Household heads were more inclined seeking production and storage extension services compared to marketing services. Farmers who have other things to do besides farming (off-farm farmers) are less likely to access any of the three categories of extension needs. Farmers who participate in PFJ are less likely to access extension for marketing purposes. The study area farmers are using seeds more than the recommended. Nonetheless household heads with family feeding responsibility were more interested in production information to increase output and storage extension services than marketing. All the categories of extension needs in the model have positive influence on yield except marketing only, emphasizing the need for extension access in general. Policy variables such as FBO and credit facilities have positive effects on maize yield. All the traditional factors of production also increase yield except quantity of maize seed.

The availability and the non-regularity were ranked high by maize farmers, whiles understanding of the extension information was the least. For extension agents, the high

extension agent to farmer ratio was their most pressing challenge, and difficulty in meeting farmer was the least.

The researcher suggested a number of recommendations including;

5.3 Conclusions

Averagely farmers get about 2 extension contacts. Considering the fact that the whole production process of maize will require more than 2 visits, the study concludes that the extension contact is low. Government through MoFA is the main source of extension service delivery for farmers in the study area.

In terms of extension needs, maize farmers access extension mostly for the purposes of production, followed by postharvest-storage, and marketing as the least. This emphasises the importance of the production aspect of maize compared with the other extension needs. Furthermore, these extension needs are found to be multiple in nature and are complementary.

Educated farmers are more likely to access extension for the purposes of all the needs, which emphasise the importance educated farmers attached to extension. Household heads are more interested in production and storage extension services than marketing, since it is mostly their responsibility to provide food for the family. They mostly will want the food to be stored throughout the year.

Farmers who engage in off-farm are less likely to access extension for any of all the three categories of extension needs. It is understood that these farmers are busy with the

other work given the farm lesser attention. Farmers with higher income, are more likely to be interested in marketing extension information, since it gives them more money. PFJ participants are less likely to access extension for marketing purposes. Extension needs are found to be complementary except for marketing and storage.

All the categories of extension need increases yield except marketing only, emphasizing the need for extension access in general. Education, improve seed, fertilizer, FBO, credit among others affect maize yield positively.

For farmers, the availability and the non-regularity of the extension services are their most pressing challenges, whiles understanding of the extension information is the least. For extension agents, the high extension agent to farmer ratio is their most pressing challenge, while difficulty in meeting farmer is least of their challenges

5.4 Recommendations

Based on the study conclusion, the following are recommended;

- Farmers have varied needs and agricultural extension service should target these multiple needs of farmers so as to increase yield.
- Farmers in the study use more seeds than recommended, and effort has to be put in educating farmers in this direction.
- Government (MoFA) has to train more qualified agricultural extension officers to meet the recommended extension agent-farmer ratio which is one extension

officer to two hundred farmers (1:200) since that is the major obstacle in delivering extension information.

- Farmers in the study area should be encouraged for form co-operatives since FBO was found to be positively related to maize yield.
- Policies aimed at increasing maize yield should focus much on access to credit facilities under flexible terms and conditions to farmers.

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APPENDICES

APPENDIX 1: Stata output for treatment equation for the Multinomial Endogenous Treatment Effect model

Number of obs = 436

Wald chi2(88) = 397.00

Log likelihood = -1485.7263 Prob > chi2 = 0.0000

	Coef.	Std.Err.	P>z
_Tcategory2			
NOOFYEARSFARMING	-0.056**	0.028	0.049
SEX	0.340	0.403	0.399
AGE	0.042	0.030	0.154
MARITALSTATUS	0.042	0.699	0.952
LEVELOFEDUC	0.763	0.515	0.138
HSEHOLDHEAD	-0.148	0.561	0.791
OCCUPATIONBESIDESFARMING	-1.256***	0.422	0.003
HSEHOLDSIZE	-0.088**	0.044	0.046
AVMONTHLYINCOMEGHS	0.568*	0.314	0.071
FREQUENCYOFACCESSINGEXTSERV	0.585***	0.196	0.003
MAINSOURCEOFEXTSERVICE	0.051	0.404	0.899
ELECTRICITYACCESS	-0.240	0.414	0.562
FBOMEMBER	0.284	0.400	0.479

ARMYWORM	-0.110	0.478	0.818
MAIZEFARMSIZEACRES	-0.018	0.080	0.818
CREDITACCESS	0.244	0.389	0.530
PFJ	0.025	0.384	0.949
_cons	-4.945***	1.867	0.008
_Tcategory3			
NOOFYEARSFARMING	-0.046*	0.026	0.072
SEX	1.146***	0.375	0.002
AGE	0.024	0.026	0.362
MARITALSTATUS	0.635	0.664	0.339
LEVELOFEDUC	0.189	0.446	0.672
HSEHOLDHEAD	1.403***	0.467	0.003
OCCUPATIONBESIDESFARMING	-0.735*	0.393	0.061
HSEHOLDSIZE	-0.124***	0.040	0.002
AVMONTHLYINCOMEGHS	0.061	0.285	0.830
FREQUENCYOFACCESSINGEXTSERV	0.601***	0.177	0.001
MAINSOURCEOFEXTSERVICE	0.151	0.370	0.684
ELECTRICITYACCESS	-0.653*	0.372	0.079
FBOMEMBER	0.388	0.361	0.283
ARMYWORM	0.456	0.412	0.268
MAIZEFARMSIZEACRES	-0.120*	0.074	0.106
CREDITACCESS	0.231	0.355	0.515

PFJ	0.904**	0.356	0.011
_cons	-1.909	1.675	0.254
_Tcategory4			
NOOFYEARSFARMING	-0.006	0.029	0.839
SEX	0.673*	0.406	0.098
AGE	0.022	0.030	0.474
MARITALSTATUS	0.355	0.709	0.616
LEVELOFEDUC	3.987***	1.119	0.000
HSEHOLDHEAD	0.884*	0.546	0.106
OCCUPATIONBESIDESFARMING	-1.826***	0.421	0.000
HSEHOLDSIZE	-0.125***	0.044	0.004
AVMONTHLYINCOMEGHS	0.836***	0.309	0.007
FREQUENCYOFACCESSINGEXTSERV	0.763***	0.190	0.000
MAINSOURCEOFEXTSERVICE	0.365	0.402	0.364
ELECTRICITYACCESS	0.101	0.419	0.809
FBOMEMBER	0.315	0.400	0.431
ARMYWORM	1.058**	0.429	0.014
MAIZEFARMSIZEACRES	-0.024	0.079	0.758
CREDITACCESS	0.088	0.387	0.820
PFJ	-0.126	0.380	0.741
_cons	-10.223***	2.139	0.000
_Tcategory5			

NOOFYEARSFARMING	0.051	0.037	0.174
SEX	0.911*	0.512	0.075
AGE	-0.063	0.040	0.120
MARITALSTATUS	1.903*	1.076	0.077
LEVELOFEDUC	-0.120	0.588	0.839
HSEHOLDHEAD	-0.968	0.952	0.309
OCCUPATIONBESIDESFARMING	-1.054**	0.537	0.049
HSEHOLDSIZE	-0.118*	0.062	0.056
AVMONTHLYINCOMEGHS	0.993**	0.433	0.022
FREQUENCYOFACCESSINGEXTSERV	-2.540***	0.578	0.000
MAINSOURCEOFEXTSERVICE	-0.872	0.565	0.123
ELECTRICITYACCESS	-0.841	0.529	0.112
FBOMEMBER	-0.158	0.505	0.754
ARMYWORM	0.550	0.645	0.393
MAIZEFARMSIZEACRES	0.021	0.101	0.835
CREDITACCESS	-0.684	0.515	0.184
PFJ	-0.439	0.528	0.406
_cons	-0.109	2.296	0.962
/Lnsigma	0.468***	0.164	0.004
/Lambda_category2	0.365	0.421	0.385

/Lambda_category3	0.531	0.381	0.164
/Lambda_category4	-1.260***	0.351	0.000
/Lambda_category5	0.596*	0.355	0.093
Sigma			

Notes:

1. category1 is the control group (base category)

2. 200 Halton sequence-based quasirandom draws per observation

3. Outcome density is normal

4. Standard deviation of factor density is 1

Note: ***, **, * means significant at 1%, 5% and 10% respectively

APPENDIX 2: Questionnaire for farmers

University for Development Studies

Faculty of Agriculture, Food and Consumer Sciences

Department of Agricultural and Food Economics

Topic: Effects of agricultural information needs delivery on maize yield in the Upper West Region of Ghana

BACKGROUND:

I am a student by name **Adinaani Nuhu** from the University for Development Studies. We are conducting a research in your community and we would be happy if you could use your time to be part of the exercise. You are therefore kindly requested to participate by providing relevant information through this questionnaire. Your identity is strictly confidential. I hope permission would be granted.

1 (0) No. I don't want to participate in the interview.

2 (1) Yes. I do want to participate in the interview.

Date of interview: **Respondent Telephone:**

Name of District/Community:

Questionnaire no:

SECTION A: GENERAL AND SOCIO-DEMOGRAPHIC CHARACTERISTICS

1. Gender? Male [] Female []
2. What is the age of the respondent?.....

3. What is the respondent's religion? ATR [] Christianity [] Muslim [] No religion [] Other (specify)--------
4. Marital status? Married [] Not married [] Never married [] Separated [] Divorced [] Widow []
5. What is your level of education? Primary [] JHS [] SHS [] Tertiary [] No formal education []
6. Are you the household head? Yes [] No []
7. Number of dependents…….
8. What other form of occupation do you have aside farming?.....
9. What is your household size?.....
10. What is your average monthly income?.....

SECTION B: EXTENSION SERVICES, NEEDS AND DETERMINANTS

1. For what reason(s) did you seek extension services? Improved seeds [] fertilizer and its application [] pest and weed control [] farm credit [] Storage and post-harvest loses [] marketing of produce [] Farmer organization [] Weather information [] Other (Specify)……

2. How many times do you access extension services for the purposes of your maize farming?.....

3. What is the main source of your extension services? Government [] Non-Government [] Traditional []
4. Which source do you prefer? Government [] Non-Government []
5. Which channel of extension communication channel (s) do you use? Radio [] Television [] Phone calls [] Text messages [] Posters [] Consultations [] Newspapers/Magazines [] Workshops [] Film shows [] Internet [] Social media [] Extension agents [] Lead and colleague farmers [] Opinion leaders [] Friends/family [] Field demonstrations [] Others (specify)…….

6. Which channel of extension communication channel do you **MOSTLY** use? Radio [] Television [] Phone calls [] Text messages [] Posters [] Consultations [] Newspapers/Magazines [] Workshops [] Film shows [] Internet [] Social media [] Extension agents [] Lead and colleague farmers [] Opinion leaders [] Friends/family [] Field demonstrations [] Others (specify)…….

7. Do you have access to electricity? Yes [] No []

SECTION C: EFFECT ON MAIZE YIELD

1. Are you a member of a Farmer Based Organization (FBO? Yes [] No []
2. Did you use pesticide for the farming season?.....
3. What is the quantity of fertilizer used on the farm?.....
4. Did you use improved

   seeds?.....
5. Was your maize infested with fall armyworm? Yes [] No []
6. Total land for agriculture (total agricultural landholding):

   …….……
7. What is the size of your maize farm?.....
8. Maize land ownership: Owned [] Rented []
9. Distance to district capital? ……..
10. Did you have access to credit for your farming? Yes [] No []
11. How long have you been farming maize? ……..
12. Distance to farm: …….
13. Participation in Planting for Food and Jobs (PFJs): Yes [] No []
14. Number of labor hours used…….
    a. Clearing……...
    b. Ploughing……...
    c. Planting……
    d. Weeding (number of times) ……...
    e. Fertilizer application (number of times) …….

f. Harvesting……

g. Carting output……

h. Threshing……...

15. What is the quantity of fertilizer used (kg) (1 bag=50kg)?

16. Machine hours: ……

17. Chemicals used (litres): …….

18. Quantity of maize seeds: ……

19. Did you use improved seeds? Yes [] No []

20. What is the total output of maize harvested? …….

21. Quantity consumed (bags) ……

22. How much sold? .....

23. Quantity given as gifts (bags) …….

24. Period, quantities and price sold

Period of sale	Quantity sold	Price sold

SECTION C: CHALLENGES IN ACCESSING EXTENSION SERVICES

1. Please arrange in order of 1 (least of challenges) to 5 (most pressing challenge) the challenges encountered in accessing extension services.

   Availability

   Distance to source

   Time consuming

   Not regular

   Understanding of information

THANK YOU FOR THE TIME.

APPENDIX 3: Questionnaire for extension officers

University for Development Studies

Faculty of Agriculture, Food and Consumer Sciences

Department of Agricultural and Food Economics

Topic: Effects of demand driven agricultural information needs delivery on maize yield in the Upper West Region of Ghana

BACKGROUND:

I am a student by name **Adinaani Nuhu** from the University for Development Studies. We are conducting a research in your community and we would be happy if you could use your time to be part of the exercise. You are therefore kindly requested to participate by providing relevant information through this questionnaire. Your identity is strictly confidential. I hope permission would be granted.

1. (0) No. I don't want to participate in the interview.
2. (1) Yes. I do want to participate in the interview.

   Date of interview: **Respondent Telephone:**

   Name of District/Community:

   Questionnaire no:

3. How often do you visit the fields and homes of farmers in a month?.....
4. Please arrange in order of 1 (least of challenges) to 5 (most pressing challenge) the challenges encountered in the delivery of extension services.

Allowances

Floods

Transportation

Communication

Safety and security

Resistance from farmers

THANK YOU FOR THE TIME.