UNIVERSITY FOR DEVELOPMENT STUDIES

ASSESSING THE CONTRIBUTION OF PLANTING FOR FOOD AND JOBS PROGRAMME ON HOUSEHOLD FOOD SECURITY IN NORTHERN REGION

SEIDU AMINU

2022

UNIVERSITY FOR DEVELOPMENT STUDIES

ASSESSING THE CONTRIBUTION OF PLANTING FOR FOOD AND JOBS PROGRAMME ON HOUSEHOLD FOOD SECURITY IN NORTHERN REGION

BY

SEIDU AMINU (BA IDS-ECONOMICS AND ENTREPRENEURSHIP DEVELOPMENT)

UDS/MEC/0017/18

THESIS SUMMITTED TO THE DEPARTMENT OF AGRICULTURE AND FOOD ECONOMICS, FACULTY OF AGRICULTURE, FOOD AND CONSUMER SCIENCES, UNIVERSITY FOR DEVELOPMENT STUDIES IN PARTIAL FULFILLMENT OF THE REQUIREMENTS FOR THE AWARD OF MASTER OF PHILOSOPHY IN AGRICULTURAL ECONOMICS

OCTOBER 2022.

DECLARATION

Student.

I, Seidu Aminu declare that except for the references to the work of other researchers, which have duly been acknowledged, this thesis is my own research work and that no part of it is presented for another degree in this University or elsewhere.

Seidu Aminu ..... ……

(Student Name) Signature Date,

Supervisor

I hereby declares that this dissertation has been prepared and presented in accordance with guidelines for supervisions of thesis set forth by University for Development Studies.

Dr. Gifty Sienso … … … ……. … … …… … … … ….

(Supervisor) Signature Date

Prof. Benjamin Tetteh Anang …… …… … … ……

(Head of Department). Signature Date

ABSTRACT

Food security is at the forefront of every global agenda especially in developing countries where most people are vulnerable to food insecurity. Globally, about 820 million people are food insecure, highlighting the enormous difficulty of accomplishing the SDGs Zero Hunger agenda. Several agricultural policies have been implemented in line with regional efforts to lessen the prevalence of food insecurity, with the goal of accelerating agricultural growth and enhancing food security level in northern region yet these have not yielded the desired results. This study evaluated the contribution of PFJ programme on food security. The objectives are to identify factors that influence farmer's decision to participate in PFJ as well as to examine the effects of participation on households' food security and to ascertain the challenges to PFJ participation by farmers in northern region. This study employed a cross sectional survey using sample size of 400 farmers (200 PFJ participants and 200 non-participants) who were selected through multi-stage sampling procedure. The determinants of participation and extent of PFJ contribution to household food security were analyzed using Endogenous Switching Regression Model whiles Kendall's Coefficient of Concordance was used to analyze household head constraints to PFJ participation. The results obtained showed that age, education, landownership, farm-income, farmer field school demonstration and political affiliation positively influenced participation. Furthermore, the results indicated that participant farmer households were food secured than non-participants. Participant households' VSLA membership, farm size, Farmer Based Organization membership and non-farm income positively influenced food security status whereas education and farm experience negatively influenced households' food security. Kendall Coefficient of Concordance results revealed that late distribution of fertilizer was the most challenged constraint while inadequate equipment for harvesting was the least constraint. The study recommends that government through Ministry of Foods and Agriculture should reinforce PFJ implementation for all-inclusive participation, ensure private sector involvement in inputs distribution and intensify field demonstration. To enhance farmers' food security status, Ministry of Food and Agriculture policies should allocate sufficient resources both human and capital to strengthen PFJ programme implementation to sustain the tremendous positive contribution to household food security.

ACKNOWLEDGEMENTS

I owe Almighty Allah my deepest gratitude for his divine protection and overwhelming favors bestowed upon me during this period of restless nights in preparation for this major scholastic success.

To my Supervisor, Dr. Gifty Sienso, I am grateful for her objective criticism and guidance towards successful completion. I am also very grateful to Prof. Joseph A. Awuni and Prof. Hamdiyah Alhassan for their invaluable advice during course class interaction and their enthusiasm to see us graduate. I also thank the Head of Department of Agricultural and Food Economics, Prof. Benjamin Tetteh Anang for all the support he offered me in the course of my stay in the department. I pray that Almighty Allah's guidance, protections and mercies would be with you in all your endeavors. To all the lecturers of Agricultural and Food Economics Department, I say thank you to you all for the advice, encouragement and serving as role model for me, especially Prof Saa Ditoh, Dr. Tampuli Abdul-Basit and Dr. Isaac Gershon K Ansah.

I also appreciate the tremendous assistance of my classmates, particularly Mr. Abubakari Kamaro and Munkaila Lambongang. Mr. Seidu Wunnam and Mrs. Azaratu Takora, my wonderful parents, you deserve special appreciation for your unwavering affection. I must state that it would not have been possible without you. May Almighty Allah grant you good health and long life. Amen! My children, Mr. Aminu Arif Nasarah, Mr. Aminu Ahmed Badimsuguru and Mr. Aminu Aslam ŋuni-nmibiɛu as well as my lovely wife, Mrs. Balila Alhassan. May God bless you all for your patience, support and understanding throughout this research.

DEDICATION

I dedicate this work to Almighty Allah in gratitude for the many blessings received prior to, during and after the compilation of this thesis.

TABLE OF CONTENT

LIST OF TABLES.

LIST OF FIGURES

LIST OF ACRONYMS

PFJ	Planting for Foods and Jobs Program
Covid-19 pandemic	Corona Virus Pandemic, 2019
MoFA	Ministry of Food and Agriculture
NEPAD	New Partnership for Africa Agricultural Development
CAADP	Comprehensive Africa Agricultural Development Program
HFS	Household Food Security.
FAO	Food and Agriculture Organization
FBO	Farmer based Organization
GoG	Government of Ghana
MDGs	Millennium Development Goals
GDP	Gross Domestic Product
GAPs	Good Agricultural Practices
ESRM	Endogenous Switching Regression Model
IFPRI	International Food Policy Research Institute
VSLA	Village Savings and Loans Associations
APRM	African Peer Review Mechanism
NFSP	National Fertilizer Subsidy Program
HFCS	Household Food Consumption Score
HDDS	Household Dietary Diversity Score
CPP	Convention Peoples Party
PPP	Progressive People's Party
NPP	New Patriotic Party
FASDEP	Food and Agricultural Sector Development Program
METASIP	Medium-Term Agricultural Sector Investment Program

WASH	Water, Sanitation and Hygiene
MTADP	Medium Term Agricultural Development Program
FINSIP	Financial Sector Investment Program
NDC	National Democratic Congress
NDP	National Democratic Party
SAP	Structural Adjustment Program
NARP	National Agricultural Research Project
PWDs	Persons with Disabilities'
ASACP	Agricultural Sector Adjustment Credit project
NLSP	National Livestock Services Project
ASSIP	Agricultural Sub- Sector Investment Project
SDGs	Sustainable Development Goals
WFP	World Food Program
NDA	Nutrient Density Adequacy
HFIAS	Household Food Insecurity Access Scale
GLP	Ghana Land Policy
GIP	Ghana Irrigation Policy
NFBSC	National Food Buffer Stock Company
BFP	Block Farms Program
AMSCP	Agricultural Mechanization Service Centers program
AAGDS	Accelerated Agricultural Growth and Development Strategy
FS	Food Security

CHAPTER ONE

INTRODUCTION

1.1 Background of the Study

Food security(FS), according to Verneau *et al.*, (2021) occurs when all people at all times have physical, social, and economic access to sufficient, safe, and nutritious food that meet their dietary needs and food preferences for an active and healthy life. "All people at all times" emphasizes the need for equal and consistent food distribution, as well as generational equality, and therefore sustainability in food production is essential (Mbow *et al*., 2019). To ensure FS implies that everyone has an equal right to equitable possession of adequate quality and quantity of food throughout the year, without jeopardizing the food needs of future generations. The term 'Safe and nutritious' in the above definition suggests that food insecurity exists if the available food is not nutritious, is polluted, or is consumed in high calories (Mbow *et al*., 2019). The available food must be safe, nutritious and healthy enough to contribute to normal human growth and well-being.

Agriculture remains a major contributor to achieving food security; this means that good policies and programmes must be design to support agricultural development course. Agricultural development and food security according to Ruel *et al*. (2018) are intricately linked to mediating factors including food production and nutrition. These indicate that if the agriculture sector (production) declines, the global food security situation will deteriorate. Meanwhile, agriculture is regarded as a vital source of food and livelihood prospects for most rural populations globally, particularly in Sub-Saharan Africa. It is estimated that the agricultural industry accounts for roughly 6.4% of world food production and over 70% of Africa's population totally depend on agriculture (Ruel *et al.*, 2018). In this regard, African

governments and heads of state commitments to food security and livelihoods in the continent have been colossal, as demonstrated by series of agricultural policies and initiatives that keep agriculture at the forefront of the region's growth (Akudugu *et al*., 2020). The African Union's (AU) Heads of State and Government, for example, launched the Comprehensive Africa Agriculture Development Program (CAADP) in June 2003, with the overall goal of achieving 6% annual agricultural growth rates, based on member countries' commitments to devote 10% of national budgets to agriculture development by 2008. This implies that the struggle for food security is a multi-stakeholder and multi-disciplinary effort that involves everyone at all levels.

Furthermore, agriculture has been a driving force for economic growth in many middle-income countries, particularly on the African continent for many years and will continue to be so (FAO, 2019). Agriculture is the principal income source in Sub-Saharan Africa (SSA), which accounts over 60% of the workforce, 35% of Gross Domestic Product, and 40% of foreign exchange revenues (Akudugu *et al.*, 2020). This suggests that the agriculture sector, particularly in Sub-Saharan Africa rural communities, provides majority of the people with livelihoods. This also means that improving the agriculture sector is a key poverty reduction strategy in developing rural livelihoods, and ensuring food security (Abera *et al*., 2021).

Also, food demand is expected to continue to rise due to a 2.5% annual population growth rate (Maja and Ayano, 2021). This may result in food shortages, particularly in lean seasons during which supply of food is relatively inadequate. In Ghana, the agriculture sector produces approximately 50% of Ghanaians grains needs, about 60% fish requirements, and 50% of Ghana’s meat consumptions (Abdulai, (2017). Additionally, the agricultural sector supplies majority of the raw materials required

in food processing industries as well as 30% in terms of agro-industry raw materials. Additionally, agriculture contributions to Ghana's GDP is enormous (Enu, 2014). The sector's contributions to GDP is 30% (Din, M.S.U. *et al.* (2022)), however, the shares of contribution (percentages) to GDP have decreased over time. For instance, agriculture's contribution to GDP waned from 29.7% to 18.3% between 2010 and 2017 (MoFA, 2017).

In terms of employment, the agriculture sector is an important source of employment. The agriculture sector employed about 44.7% of the Ghanaian population, with the majority of people working in food production, fishing, and cattle rearing, while others work in agricultural marketing (Ali *et al*., 2021). In addition, the sector contributes significantly to foreign exchange earnings growth. Bayale *et al.*, (2022), reported that, Ghana's export revenue increased by 148.3 million US dollars (12.9%).

Despite the above contributions, the agricultural sector continues to face challenges that prevent it from achieving maximum productivity. Some of the problems include insufficient market information, climate change, pests and diseases, over-reliance on rainwater agriculture, high post-harvest loss, low agricultural production prices, and insufficient use of improved seed. Others include insufficient fertilizer application, inadequate supply of extension officers to farmers, poor market ties among consumers and producers, and narrow use of Information, Computer and Technology tools MoFA-PFJ (2017). As a result, agriculture development, which is considered as a solution to realize foods security among these obstacles, is unthinkable.

Against this background, the government of Ghana, through its implementing agency, launched a precise, complete, and holistic policy initiative called Planting for Food and Jobs (PFJ). This policy was formulated based on lessons learned from execution of previous agricultural programs. Provision of improved subsidized fertilizer, provision of improved subsidized seeds, extensive extension services delivery, guaranteed market for outputs, and availability of e-agriculture platforms for easy dissemination of essential information among farmers are among the five holistic intervention areas included in the PFJs program. The PFJ programme was a four-year designed programme (2017-2020) with the main aim of empowering smallholder farmers by making available inputs and output markets as incentives to improve crop productivity. It also aims at diversifying livelihoods opportunities in the agricultural value chain, so that food shortages and over reliance on imported food would be minimized. Specifically, the PFJ program has pleasing objectives, which includes ensuring food self-reliance for maize, soya beans and rice food crops, and as well to provide livelihood opportunities, especially for the youth and women, (MoFA- PFJ 2017). The expectation of this programme's interventions is that yields of food crops such as maize, rice and Soya beans should increase by 30%, 49% and 25%, respectively (MoFA-PFJ, 2017). This suggest that the programme is unique in its design and implementation and broad in its interventions as it encompasses all the activities in the production system.

Since the start of PFJ implementation, many researchers have done several studies on varied interventions of PFJs programme. For instance, Azumah 2020 focused on the programme's contribution to improved seed security for farmers, Augustine and Tekuni., (2020) Tanko *et al.,* (2019a) Lambongang *et al., (*2019) outlined PFJs contribution on crops productivity, whiles Mabe (2018) assessed the implementation

success and farmers' awareness of PFJs Programme, of which the impact of PFJ programme proved positive on farmers wellbeing.

In summary, food security is when all people at all times have physical, social, and economic access to sufficient, safe, and nutritious food that meet their dietary needs and food preferences for an active and healthy life. Since agriculture remains, a major contributor to achieving food security, it must be given the needed attention through holistic smart agricultural policy like PFJ.

1.2 Problem Statement.

Food security is at the forefront of every global agenda especially in developing countries where most of the people are vulnerable to food insecurity. Globally, about 820 million people are hungry, highlighting the enormous difficulties of accomplishing the SDGs Zero Hunger goal agenda (Boliko 2019). In Ghana, the FS situation is considerably not different from the global FS status. It is estimated that 5% of the population (1.2 million people) suffered from food insecurity, with then three regions (then Northern region, Upper East and Upper West regions) in northern Ghana experiencing the worst condition with over 10% of the population from northern region being food insecure (WFP, 2019). This is further backed by a recent empirical evidence by Dagunga *et al.* (2020) who examined the multidimensional poverty situation of Ghana and revealed that the northern belt records the highest in multidimensional poverty relative to the middle and coastal belts. This is because, access to food is a function of many factors including income and individual living standards; it is imperative that a poorer region is likely to be more food insecure as revealed by the WFP (2019).

To address the problems of FS, several agricultural policies have been implemented in line with regional efforts to lessen the prevalence of food insecurity. These agricultural policies were implemented with the main goal of accelerating agricultural growth and enhancing food security level in the region, yet these have not yielded the desired results. For example, the Comprehensive African Agricultural Development Programme (CAADP) goal was to eliminate hunger by reducing poverty and guaranteeing food security (Mabe, 2018). Agricultural productivity and food security were prioritized in the Medium-Term Agricultural Sector Investment Programme (METASIP) strategy (Ali *et al.*, 2021). However, the programs' implementation success was inefficient and short-lived, despite the considerable amount of resources allotted to the northern region of Ghana (Ayerakwa *et al.*, 2020).

Following the implementation inefficiencies of these programmes, the government of Ghana through Ministry of foods and agriculture as an implementing agency launched the PFJ programme in 2017 with the overarching goal of producing more food to reduce the incidence of food insecurity, as well as making a more conducive environment for livelihoods creation in agriculture, especially for youth and women. (Augustine *et al.*, 2019).

Since the implementation of PFJ, many researchers have conducted several studies on various aspects of the PFJs programme. For instance, Azumah (2020) Augustine and Tekuni., (2020) Tanko *et al*., (2019) Lambongang *et al.*, (2019) Mabe (2018). To the best of my knowledge, the only study that exclusively assessed the PFJ programme impact on households food security was Nurudeen (2019) in Wa West district. His study used the Propensity Score Matching (PSM) to assessed food

security; however, the PSM model used could only account for observed food security level but not counterfactuals. His findings cannot also be generalized across the whole country because it was conducted in one district. From the arguments above, this current study was conducted to ascertain the contribution of PFJ programme on food security using the Endogenous Switching Regression Model, which can account for both observed and unobserved food security statues among households in the study area. Furthermore, given the alarming food insecurity situations and programme promising deliverables, little research has been conducted to validate PFJ contribution to food security in the northern region.

1.3 Research Questions.

This research sought to find possible answers to these research questions.

1. What are the factors that induce farmers' decision to participate in Planting for Food and Jobs programme?
2. What is the effect of PFJ Programme participation on smallholder farmer's household food security?
3. What are the constraints that hinder farmer's participation in PFJs programme?

1.4 Objectives of Study.

The general objective of the study is to evaluate the contribution of Planting for Food and Jobs programme on smallholder farmer's food security in northern region of Ghana.

The specific objectives of the study are:

1. To determine factors that influence farmers' participation in PFJs programme.

2. To examine the effect of participation in PFJs programme on household food security.
3. To identify and analyse constraints that hinder farmer's participation in PFJs programme.

1.5 Hypothesis of the study.

The hypothesis that this study sought to test is:

1. There are no statistical and significant variations between participants and non-participants food security in northern region.

1.6 Justifications.

Governments globally have implemented several policies targeted at warranting foods security following the United Nations General Assembly declarations on ending thrilling hunger and poverty by 2030. (FAO, 2019). The Planting for Foods and Jobs programme is an on-going programme that needs some degree of monitoring along its implementation phases to ensure that its implementation progress is on track. The results of this study would be useful to the implementing government and her Ministry of Food and Agriculture concerning the achievements and or challenges related to the programme implementation on food security in the region, to inform next-level decision-making on allocation of scarce resource to improve programme rollout. The results of this research would also serve as an input for Ministry of Food and Agriculture, Philanthropies, Non-governmental Organizations and other developmental organizations with a view of formulating policies for new food security interventions design.

Additionally, researchers and extension service providers need feedback from programme beneficiaries after a successful programme implementation. This study found a positive impact of the PFJ on household food security outcome-oriented feedback to actors and all stakeholders, which may be useful for designing similar projects elsewhere in future.

Lastly, this research results would serve as a basis for further studies and the research findings will contribute to literature on policy implementation and food security in Ghana.

1. 7 Organization of this Study.

This study is organized into five main chapters. Chapter One contain the background to the study, problem statement, research questions and objectives, as well as hypothesis for the study. Other areas considered in the chapter one are the justification for the study, thesis hypothesis and the organization of the study. Chapter two reviewed key literature on agricultural policy interventions in Africa and Ghana, and the current PFJs Programme. Again, an empirical review on concepts of food security dimensions and factors that determine farmers' decision to participate in policy programmes was comprehensively reviewed. The research methods are detailed in Chapter three. Which consist of study design, data sources and types, the conceptual framework, data analysis and presentations, research area, sampling and sampling techniques, variable descriptions, measurements and apriori expectations. The presentation of results and discussed findings are in Chapter four. Chapter five detailed the summarized findings, conclusions and suggested recommendations of the study.

CHAPTER TWO

LITERATURE REVIEW

2.1 Introduction

This chapter reviewed literature on key areas of the research, which include agricultural policy interventions in Africa, overview of agricultural policies in Ghana and PFJs Programme. The chapter also reviewed literature on concept of food security, dimensions of food security and reviewed literature on determinants of food security, determinants of participation in past agricultural policy programmes and description of explanatory variables.

2.2 Agricultural Policies in Africa

2.2.1 Importance of Agricultural Policies

The achievement of household level food security and improving on livelihoods establishment for farmers, whose labor commitments have contributed greatly to the survival of developing countries are in the forefront of government's development agenda. According to Mabe (2018), policies are very instrumental in achieving development goals that aimed at transforming the agricultural sector. Globally, both the Millennium Development Goals and Sustainable Development Goals aimed at eradicating hunger and ensuring food security through increased food production. These goals are based on increasing agricultural production and achieving global food sufficiency through agricultural research and industrial development of improve new technologies. It is imperative to promote economic growth through poverty reduction and thus responding to the Sustainable Development Goals, even though the structural adjustment program (SAP) weakened the agricultural sector in Sub Saharan Africa (Mabe, 2018a).

Report by Olabanji *et al.* (2017) indicated that the agriculture sector contributions to economic development of most developing economies is in four main domains; foreign exchange contribution, factor contribution, product contribution and market contribution. This suggest that the sector is fundamental for the overall economic growth, and very instrumental in addressing food insecurity, poverty and socio-economic inequality in developing economies, particularly in the sub-Saharan-Africa. Generally, consistent increases in the agriculture productivity contributes greatly to economic empowerment and poverty reduction among farmers. However, agriculture productivity, and production growth in most Sub Saharan countries are very low (Zimmermann *et al.*, 2009).

Furthermore, it is reported that donors and African leaders neglected the agricultural sector since the late twentieth century (Zimmermann *et al.*, 2009). Around the 1990s, donors, Heads of state and governments of African countries started developing initiatives to revitalize the undeveloped agricultural trends in Sub Saharan Africa. However, those initiatives failed miserably, with the reasons pertaining to high influence of climate change and land degradations been predominant, thus, affecting its progress. The sector was also slow in reacting to new directives posed by development cooperation due to its strong connections and openness to many other sectors, most often its vulnerability and its disorganized nature. Nonetheless, good agriculture strategies, programmes and policies are very instrumental to rejuvenate the sector and to create an enabling environment apt enough to attract donor interest to new aid modalities.

2.2.2 The New Partnership for Africa Development

The New Partnership for Africa's Development is an economic programme of the African Union, formally established in 2001**.** This initiative had acknowledged the importance of agriculture for reducing poverty and economic evolution and the weakness of the agricultural policies in member states. According to Mabe (2018a), African continent is in a continuous process of designing agricultural policies as means to achieving self-sufficiency via increasing total factor productivity through African continental economic policy. Kayode *et al*. (2020) opined that NEPAD is the product of the African leader's recognition of the fact that Africans are in a spectacular poverty, and are as well backward in terms of development compared to the prosperous developed world. Africans are in a state of continuous marginalization from neo-colonialization, process of globalizing and social exclusion of the vast majority of its people (Kayode *et al*., (2020).

Kayode *et al*. (2020) also stated that the New Partnership for Africa Development initiative is a statement of African leaders' commitment to combat poverty and place African continent to a sustainable development path for all. This suggests that the idea surrounding the formulation of this initiative is poverty alleviation via African unity. Many studies have revealed that previous attempts to solve regional developmental problems failed because national leaders lacked strong will to make regional cooperation a reality. According to Maloka (2006), who responded to and explained the new initiative's response to World Health Organization's report, NEPAD is neither an institution nor an organization, but rather "a programme" of the Organization of African Unity (OAU). As a result, it must not be viewed as a self-contained entity. It is not the same as the African Union.

The long-term goal of the New Partnership for Agricultural Development Programme is to eradicate poverty, accelerate prosperity, and restore Africa's good name in the global process (Mabe, 2018). According to Zimmermann *et al.* (2009), the New Partnership for Africa's Development, programme's goal is to improve policy making from a broader viewpoint. In this way, the initiative's member states will actively participate in and ensure ownership of development policies and strategies. This partnership programme is also responsible for ensuring that policies and initiatives formulated are in perfect alignment, and embed in regional and pan-African agendas. Additionally, member states have been given authority to ensure evidence-based policy formulation, including peer learning and review, as well as strengthening partnerships to boost private and public sectors investments. The main pillars of NEPAD, according to Ijeoma (2012), are promotion of peace and political stability; enshrining and protecting democracy, poverty extermination; constant economic growth and development; and improves Africa's competitiveness and strengthening Africa's participation in global institutions.

This initiative's ownership and implementation control by member countries differs from previous initiatives. It is clear that, NEPAD has a concise decision-making and control structure. Thus, the highest authority of its implementation is AU's Heads of states and government Submit, which takes its clue from NEPAD Heads of states and Governments Implementation committee and the steering committee (which constitutes personnel ambassadors). According to Dieye (2004), the NEPAD designed objectives in Africa differed from previous projects in that NEPAD wants Africa to be viewed as a single and unique operating economic area going forward. This is because international trade rules and the globalization process expose agriculture and food markets to fierce competition on the global market where

Africans are too weak and little to respond alone. As a result, the NEPAD/AU project is the most important endeavor to enable African countries to collaborate in order to vividly construct their own political space and resist external market forces.

According to literature, NEPAD initiative had some flaws and opportunities. Politically, NEPAD had been rebuked for selling off African continent to neoliberal market philosophy. Others criticized NEPAD for lacking clear strategy and strong leadership, while others viewed it as a top-down initiative (Kayode *et al*., (2020). According to Kayode *et al*. (2020), some of NEPAD's bleak issues and prospects include its ability to cancel debt and refund state funds plundered by unscrupulous authorities. The NEPAD initiative aided poverty reduction by facilitating the repatriation of stolen funds through vigorous persuasion of perpetrators, who were encouraged to invest the funds in Africa rather than helping already, developed countries develop further by keeping the funds in foreign banks in Europe and America. The project has also urged member countries to diversify their African output.

Finally, African leaders acknowledged Africa's extreme poverty and lagging development in comparison to the rich industrialized world. African leaders also recognized that the continent of Africa is experiencing marginalization because of neo-colonialization, the globalization process, and social exclusion of its people, as well as importance of agriculture for reducing poverty and increasing economic growth, which is believed to have direct bearing on African foods security. This suggests that this initiative's fundamental concept is poverty eradication through African unity and development. The ability of the NEPAD's effort to cancel debt and return state revenues stolen by corrupt leaders, as well as achieve poverty

reduction through repatriation of stolen monies and diversification of African productions, are its main prospects.

2.2.3 Comprehensive Africa Agricultural Development Programme (CAADP), African Peer Review Mechanism (APRM) and Economic Community of West Africa Agriculture Policy (ECOWAP)

The NEPAD programme created Comprehensive Africa Agricultural Development Programme in June 2003, with a membership of more than twenty-six countries. CAADP was created as part of the NEPAD project, and its fundamental concepts, norms, and goals in terms of ownership, participation, evidence-based results-orientation, and the Millennium Development Goals aligned with NEPAD's overall manifestation (Brüntrup, 2011). According to Kayode *et al*. (2020), CAADP deliberately focused its investment efforts on four mutually reinforcing "pillars": (a) Agricultural research, technology dissemination, and adoption; b) enhancing rural infrastructure and trade-related capacities for increased market access; c) increasing food supply and reducing hunger; d) Sustainable land management and reliable water control systems. This indicates that CAADP's efforts to provide food security in Sub-Saharan Africa is directly seen in pillar three, which aims to enhance food supply and reduce hunger. It was projected that attempting to increase the productivity of 15 million small farms through enhanced technology would cost US$7.5 billion (Kayode *et al*., 2020). This means that African leaders and donors have committed a significant amount of money on CAADP in improving Africa's agricultural technology and food security.

The fundamental purpose of the CAADP initiative was to achieve higher levels of economic growth through agricultural development as a means to eradicating

hunger, reducing poverty, ensuring food security and increasing exports (Zimmermann *et al*., 2009). This was in line with Maputo Declaration, which demanded that all CAADP initiative members allocate ten percent of yearly national budgets to agriculture sector investment. Such investments were expected to generate a 6% growth rate in the sector. This is envisioned as an economic plan for all to benefit from increased economic growth and development. CAADP would not have been feasible without national contributions, according to Brüntrup (2011). Although the international, continental, and regional levels are significant components of CAADP implementation, however, the real value of CAADP is ultimately determined at the country level.

From 2003 to 2005, the CAADP's first phase formulated isolated bankable investment proposals at the national level. However, neither countries nor donors took on such initiatives, resulting in an increase in Africa's agricultural sector expenditure from US$ 4.2 billion to US$ 8.7 billion between 2000 and 2005. According to Pernechele *et al*. (2018), only five nations (Ethiopia, Mali, Rwanda, Senegal, and Uganda) raised their agricultural expenditure percentage of overall public budgets in 2015, while seven countries decreased it namely, Burundi, Benin, Tanzania, Burkina Faso, Kenya, Senegal and Egypt. Only a few countries, as promised in the declaration will spend more than 10% of their total public budget in the following years. This means that in the first phase of CAADP, approximately 72% of member countries, including Ghana, failed to meet their commitments to the declaration.

According to NEPAD 2003, as cited in Mabe (2018), the second agricultural-related pillar of NEPAD is the African Peer Review Mechanisms (APRM), which

developed a framework of governance that included agriculture. The APRM's major goal was to promote democratic governance, economic management, corporate governance, and socioeconomic development. Land accessibility and security to land tenure, inputs quality such as seeds, fertilizer and machinery services, grazing lands maintenance and pasture burning, access to rural credit, and providing public goods such as roads network, irrigation infrastructure, markets, and prices information were some of the governance issues that were relevant to the agricultural sector.

Following a rigorous examination of NEPAD's implementation at the regional level, it was determined that a regional agricultural policy was needed to address agricultural and food concerns in West Africa, resulting in the formation of ECOWAS (Blizkovsky *et al*., 2018). The basic goal of ECOWAS' regional agricultural strategy was to contribute sustainable manner to meeting the population food demand, socio-economic development, poverty reduction in member states, and to minimize inequalities among territories, zones, and nations." This primary goal was then fragmented into the following precise objectives; (1) food security for regional citizens, (2) reduction of food dependence and achieving food sovereignty, (3) creating markets for producers, (4) creating jobs with guaranteed incomes to boost the standard of living, (5) sustainable intensification of production systems, (6) adopting appropriate funding mechanisms, among others. Thus, the long-term vision of ECOWAP was to enable member countries to explore their potential to achieve sustainable food security, increase producers' income and expand trade among the member states and between the sub-region and the rest of the world (Mabe, 2018a).

In summary, agricultural policies play a very important role in achieving many development programmes goals, including goals design to transform the agricultural sector for enhanced foods security. Both the MDGs and the SDGs aimed to eradicate hunger in all its forms. The NEPAD programme, CAADP, APRM and Economic Community of West Africa Agricultural Policy had flushing aims of improving the agricultural sector development and ensuring foods security in Sub Saharan Africa continent. This is evident in CAADP's pillar three; to increase food supply and reduce hunger evident in the huge amount of resources invested to enhancing food security in Africa through agricultural research and technology adoption. The commitment of African countries to the Malabo declaration was very low. Only five countries increased the share of agricultural expenditure within total public budgets in 2015, seven countries were able to reduce whiles some few countries exceeded the 10% spending expenditure on total budgets in subsequent years. This low commitment undoubtedly affects the food security levels negatively.

2.3 Overview of Agricultural Policies in Ghana

Mabe (2018) defines policy as a plan of action produced and adopted by an institution, organization, or government for implementation with the purpose of obtaining a desired outcome. It could also be viewed as a plan of action implemented nationally, regionally, or at the districts levels to target a certain sector of the economy or the entire economy. Agricultural policies, trade policies, and environmental policies are just a few of the policies available. Since independence, Ghana has established a number of agricultural policies and initiatives that have defined governments and development partners' investment priorities.

The Structural Adjustment Programme (SAP) was a nationwide programme in the 1980s and 1990s that influenced many sectors of the economy through a variety of other programmes like the Financial Sector Investment Programme (FINSIP) in the early 90s and Vision 2020s Framework, from which Medium-Term Agricultural Development Programme (MTADP) (1991–2000) was carved. The National Agricultural Research Project (1991–1999), National Agricultural Extension Project (1992–2000), Agricultural Sector Adjustment Credit Project (1992–1999), National Livestock Services Project (1993–1999), and Agricultural Sub Sector Investment Project (1994–2000) are all part of the MTADP. The Food and Agriculture Sector Development Policy (FASDEP I) was developed shortly after the MTADP, as part of the Accelerated Agricultural Growth and Development Strategy (1996–2000). Agriculture Services Sector Investment Program (2002–2006) was amended in 2006 and 2007 to form FASDEP II (2009–2015) (Dittoh *et al.*, 2013). All of these programmes and projects aided agriculture sector and food security development in the country.

According to Mockshell (2016), the Agricultural Mechanization Service Centers initiative was established in 2007 to boost farmers' access to mechanization services in order to increase domestic food production. This means that farming with machines like tractors were made flexible to farmers under this initiative. Following the global food crises in 2008, the Fertilizer Subsidy Program (FSP), Block Farms Programme (BFP), and National Food Buffer Stock Company were all implemented concurrently and all aimed at attaining domestic food security. The Ghana Irrigation Policy and the Ghana Land Policy are two more government-led policies and programmes that were relevant to agricultural development and food security.

The Food and Agriculture Sector Development Policy II is based on the strategies of the Food and Agriculture Sector Development Policy (FASDEP I) (Babu, 2017). FASDEP I, according to Mabe (2018), failed due to a lack of infrastructure, insufficient access to input and product markets, and insufficient access to financial and technology services, among other factors. This means that implementation challenges and lessons learnt from FASDEP I were modernized to form the FASDEP II. According to Babu (2017), FASDEP II's objectives are in line with Ghana's Poverty Reduction Strategy I, II and Ghana Shared Growth and Development Agenda. FASDEP II was designed to satisfy targets set by the Economic Community of West African States, the CAADP framework, and the MDGs (Dittoh *et al*., 2013). Except for vulnerable and marginalized populations, FASDEP II chalked nationwide recommendations for its in-depth consultation process by all stakeholders; including government, academics, and relevant NGOs (Babu, 2017).

Food security and poverty reduction were also important components of Medium-Term Agriculture Sector Investment Programme. According to Essegbey *et al*. (2015), the METASIP strategy is an adopted tool for implementing FASDEP II, the Maputo Declaration, the ECOWAAP, and NEPAD's CAADP, in that it was designed to achieve an annual agricultural growth rate of 6% and a 50% reduction in poverty. According to Kayode *et al*. (2020), METASIP paves the way for agricultural sector visions of at least 6% to 8% growth rates, which were required to boost growth for rural transformation and poverty reduction. The food security and emergency preparedness strategy for METASIP had direct impact on food security enhancement since it was aimed at improving spectacular cultivation of staple food crops such as maize, cassava, rice, yam and cowpea in northern Ghana. METASIP

aimed at improving nutrition through nutrition education, advocacy, and fortification of foods.

In addition, METASIP focused on poor people's livelihood diversification, food preservation and distribution to reduce post-harvest losses, and producers' capacity building in terms of best harvesting practices, transportation, and preservation methods, as well as introducing grading techniques to farmers and linkages that existed between production agents and marketers to increase demand and supply of farm produce. METASIP was known by its sector-wide approach, as the programme involved an extensive array of stakeholders with greater privatization for economic growth and development. However, some stakeholders criticized METASIP for its inability to evolve in similar manner as FASDEP II did and as such did not involve an in-depth multi-sectoral consultations, hence METASIP lacked ownership backup particularly, non-MOFA stakeholders and was criticized for lack of concrete based-evidence (Dittoh *et al.*, 2013).

Fertilizer Subsidy Programmes (FSP) in Ghana is another programme for agriculture development and food security over many years. Generally, crops do well on very fertile land, however they fail woefully due to climatic variability, which adversely affects crop yields and household food security (Akudugu *et al.*, 2012). This means that households who completely depends on agriculture for food, gets little harvest when the soil is not fertile, where food availability and accessibility are seriously affected resulting in little or no surplus to take care of non-farm needs (Vondolia *et al.*, 2021; Scheiterle *et al*., 2019). According to Mabe (2018), the cost of fertilizer in Ghana is high causing low rates of fertilizer application. PFJ therefore, aimed at providing farmers with fertilizer at a subsidized cost.

According to Hill and Kirwan (2015), the rate of fertilizer application is still low of about 23.9% despite the subsidy packages in the country, probably due to low access to subsidized fertilizer. Mustapha *et al.* (2016) also asserted that access to fertilizer under the Ghana fertilizer subsidy programme is about 42.6%, the reason for diminishing soil nutrients and low yields among smallholder farmers in Ghana.

Despite the huge volume of fertilizer injected into the sector, the programme encountered a number of difficulties. According to Resnick and Mather (2016), the Ghana Fertilizer Subsidy Programme was plagued by excessive administrative costs, delay in the supply of subsidized fertilizer, lack of openness among stakeholders, and a high level of political manipulation. As a result, these subsidy programmes were phased down, and the market for inputs was liberalized as part of the structural adjustment process (Yawson *et al.*, 2010). The re-introduction of Ghana subsidy programme was done in 2008, which was purposely aimed at increasing productivity in accordance with governments commitment to ensure food security and to improve farmers livings standard (Alhassan *et al.*, 2020). However, others viewed the re-introduction of fertilizer subsidy as a strategy for addressing the challenges confronting agricultural sector development through increased smallholder farmer crop productivity for sustained food security (Benin *et al*., 2013).

Over decades, Ghana's fertilizer subsidy programmes have been implemented in the country and the consequent effects are that these programmes have succeeded in increasing the utilization of major farm inputs resulting in boosting agricultural productivity from 2008 to 2015 (Resnick and Mather, 2016). Table 2.1 presents the actual quantity of subsidized fertilizer increasing trend except for the year 2012 and 2013 where the quantity declined in 2013 and then increased to 180,000Mt in 2015.

This means that spectacular amount of subsidized fertilizer was injected into the country for Ghanaian farmers.

Table 2.1: An Outline of Ghana FSP size (2008–2015)

Year	2008	2009	2010	2011	2012	2013	2014	2015
Actual subsidized fertilizer (MT	43,176	72,795	91,244	176,278	173,755	166,809	n/a.	180,000

Source: (Resnick and Mather. 2016).

However, despite these huge investments in fertilizer subsidy programmes, studies have found conflicting results regarding the use of fertilizers. For instance, Alhassan *et al* (2020) found that an increased in fertilizer application rates increases maize productivity. However, Azumah and Zakaria (2019) found negative correlation between subsidized fertilizer application and rice productivity. This suggest that fertilizer application is not a sufficient condition for increased output.

2.4 Planting for Foods and Jobs Programmed

Ghana's PFJs programmed is government-led agricultural initiative that encompasses the entire agricultural production system in a holistic and unique way, with the goal of addressing the country's food security and livelihoods by improving access to agricultural inputs-outputs markets in a value chain system. The programme was a four-year initiative that ran from 2017 to 2020. According to MoFA-PFJ (2017), global evidence suggests that multiple pathways in the agricultural sector are necessary to trigger structural transformation through increased agricultural productivity by virtue of real income improvements,

employment generation, rural non-farm multiplier and food prices effect. Conversely, the ability of farmers to participate and benefit from these increased agricultural productivity gains has been hindered by technology adoption and constraints to market access barriers.

According to other writers, the PFJ programme was to purposively mobilized and enabled farmers access to both inputs and outputs market as incentives used to directly encourages smallholder farmers to increase farm productivity and generates livelihoods along agricultural value chain systems (Mabe, (2018) Tanko *et al*., (2019). This means that farmers' access to farm inputs will be flexible and easy in sufficient quantities to meet production input needs and sufficient quantities of fertilizers. The good harvest of farmers would guarantee a good market at the output markets avenues established by the programme.

Existing literature also shows that fertilizer subsidy programmes alone is a necessary condition and cannot guaranteed farmer access to subsidized fertilizer (Akudugu *et al*., 2012). Improving subsidy reachability as well as farmers' managerial and technical skills through capacity building, and enhancement of market-based solutions within the output and input supply chain is necessary (MoFA-PFJ, 2017). It is forecasted that upon successful programme execution maize yields will increase by at least thirty percent, rice yields by forty-nine percent, soybean by twenty-five percent and sorghum by twenty-eight percent as stepping stones to achieving the overall goal of enhanced agricultural productivity, improve incomes as well as solve food insecurity and livelihoods challenges in Ghana. According to His Excellency Nana Addo Dankwa Akuffo Addo, "the Planting for Foods and Jobs Programme will create seven hundred and fifty thousand (750,000)

jobs and ensures food security". He stated this during the program launched on Wednesday, 19 April 2017, in Goaso. This means that the execution of this programme had some level of commitments from major stakeholders in the country; hence, multitude stakeholders' support would greatly facilitate its deliverable achievements.

2.5 The Concept of Foods Security

2.5.1 Defining Foods Security

The concept of food security has systematically advanced to mean different things over time since its advent as an issue in the 1970s, which has over thirty definitions per literature (Yousaf *et al*., 2018). Foods security was used to mean, availability of adequate world food supplies of basic foodstuff at all times to sustain sufficient food consumption and to reduce production and price fluctuations in the late twentieth century (Kuwornu *et al*., 2011). According to Pinstrup-Andersen (2009) the concept "food security" originally describes whether a country had access to sufficient food to meet dietary energy requirements. Since national food security do not guarantee household food security, issues of distribution of available food became critical to ensure food access at household level. This, attracted scholars and practitioner's attention in the mid-1970s, to re-define food security as access by all people to enough food to live a healthy and productive life.

According to Bashir *et al*. (2013) food is said to be secured when food is available at all times and all people have means of access to it; that it is nutritionally adequate in terms of quantity, quality and variety and that it is acceptable within the given culture. This definition suggests that it is when the aforementioned conditions are met that a given population can be regarded as food secured. In 1996, the Food and

Agriculture Organization modernized the definition of food security to include the nutritional value and food preferences following its emergence as an issue in the 1970s. Which brought to light four dimensions of food security at the 1996 World Food Summit as "food security exists when all people, at all times, have physical and economic access to sufficient, safe and nutritious food that meet their dietary needs and food preferences for a healthy and active life"(Pinstrup-Andersen, 2009).

The term "All people at all times" in the above definition implies the need for equal and consistent distribution of food, it also implies the need for equality between generations, and therefore "sustainability" in food production is increasingly recognized (Mbow *et al.*, 2019). This suggest that all people have equal rights to equitable possession of satisfactory quality and quantity of food all year round without compromising the food needs of unborn generations. The term safe and nutritious foods that meets food choices for an active and healthier living suggest that food insecurity exist if the available food is not nutritious, is contaminated and/or is consumed in high calories (Mbow *et al.*, 2019). Food availability, accessibility and utilization of food is a necessary condition but not sufficient condition until the available food is accessed and utilized in their right nutritional value. The available food must be of safe condition, nutritious, and healthier enough to contribute to normal human growth and well-being. This is a widely accepted definition, however, it excluded environmental and health care factors in ensuring food hygiene since the safest and nutritious diet served in a filthier environment is the most contaminated food hence unsafe for human consumption (Adzitey *et al.*, 2020).

Ingram (2020) defines food security given much priority to quality and environmental factors. According to him, food security was defined as "when all people, at all times, have physical, social and economic access to food which is safe and consumed in sufficient quantity and quality to meet their dietary needs and food preferences, and is supported by an environment of adequate sanitation, health services and care, allowing for a healthy and active life. This definition suggests that food security is stout towards addressing the rising stunting and wasting in children following the change in notion and rethinking among community nutritionist. It has also been applauded for its Water, Sanitation and Hygiene (WASH), and nutrition component inclusiveness to the definition; hence, good nutrition security in a WASH friendly environment is the best for healthier and active wellbeing (Adzitey *et al.*, 2020).

Given a comprehensive thought over these preceding definitions, one can deduce food insecurity to mean, when people do not have physical, social and economic access to sufficient, quality and nutritious food and that the food does not meet their dietary needs and food preferences and that, these people suffer the related consequences. It could also mean that food without much priority and consideration to food quality, food safety and environmental cleanliness (WASH) is not considered food security since unsafe and contaminated food is the most hazardous to human health and wellbeing. The magnitudes of food insecurity vary among and between people. According to Bashir and Schilizzi (2013), food insecurity could either be severe or less. Food insecurity is considered severe when foods intake is continuously insufficient in meeting dietary energy requirements. Food insecurity is less severe when food quality is reduced and variety of dietary intakes are reduced,

which probably could lead to over weights in adults and adverse psychological development in children.

In summary, the concept "food security" systematically evolved since its emergence as an issue in the late twentieth century. This current study follows the definition of Food Security by Ingram (2020). According to him, food security is "when all people, at all times, have physical, social and economic access to food which is safe and consumed in sufficient quantity and quality to meet their dietary needs and food preferences, and is supported by an environment of adequate sanitation, health services and care, allowing for a healthy and active life.

2.5.2 Dimensions of Foods Security

The world food summit in 1996 brought to light four main dimensions of food security pertaining to all levels, which are multidimensional encompassing several key influential factors such as climate change, civil conflicts, natural disasters, and social norms (Zhou *et al.*, 2019). According to Abegaz (2017), the concept food security is complex which encompasses four dimensions, namely: food access, food availability, food utilization and food stability (sustainability).

2.5.2.1 Availability of Food

Food availability is supply of food in right quantity and quality in a given geographical location (Bawa, 2019). This suggest that food is said to be available if the right quantity and quality of consumables are provided to a given set of population at a particular locality at a stipulated time. Availability of food is achieved when sufficient quantity of food is consistently available to all individuals within a country (Bashir and Schilizzi, 2013; Abegaz, 2017). World Food Programme (WFP), 2018 defines food availability as the physical existence of food

at all levels in a country at any particular point in time. This suggests that available food must be at all levels of consumption including the national, household and individual levels in a country. The food should be of sound quality, quantity and consistent in its availability for all people at all times.

According to Bashir and Schilizzi (2013); Abegaz (2017); Bawa (2019), sources of food supply involve local food production, rearing ruminants, fish farming and wild forest or animals' products. In addition, the availability of food is determined and enhanced through importation of consumable goods into a given location. Other structures like good road networks, perfect information delivery and well-functioning market systems influence the availability of foods in a given location. Akudugu *et al*. (2012) indicated that transportation systems influence food availability, because the distribution of finished goods from production to consumption is necessary. This in some case depend on the available means of transport. The availability of food is adversely determined and is affected by poor transport systems which impede the distribution of food items from producers to consumers.

2.5.2.2 Access to Food

Akudugu *et al*.(2012) stated that, food accessibility is the ability of household to obtain sufficient quality and quantity of foods that satisfies their nutritional needs. Accessibility is ensured when households and all individuals have adequate resources to obtain appropriate foods for a nutritious diet (Abegaz, 2017). This means that removing the barriers of accessing available foods is the duty of individual households through their available incomes. According to Bashir and Schilizzi (2013), access to available foods at any particular time is a function of

household income and the price of available food. Access to food is guaranteed when all household have enough resources to obtain food in sufficient quantity, quality and diversity for a nutritious diet (WFP, 2018). Accessibility also depends on the physical, social and policy environment.

Food accessibility is determined by households' incomes purchasing powers, production stocks and or through foods transfers from relatives, importation and individual's ability to access social support systems in the society (Darfour and Rosentrater, 2016). The presence of physical and financial assets as well as the socio-cultural and political barriers influence household's access to food. On the other hand, FS is adversely affected by social insecurities such as conflicts, border closures and collapse of social safety net institutions, which protects lower income people (Haddad *et al.*, 2016).

2.5.2.3 Food Utilization

Bawa (2019) defines food utilization as a measure of a population's ability to obtain sufficient nutritional intake and nutrition absorption over a specified period. This proposes that the ability to digest consumed food and assimilate food nutrients into the body system for a normal human development is the purpose for accessing available foods. According to Abegaz (2017), food utilization is the consumption of food, that provides sufficient energy and essential nutrients including water, adequate sanitation and health care to reach a state of nutritional well-being where all physiological needs are met. It also refers to the ability of the human body to take food and convert it to useful micronutrients for body absorption. Food utilization is the ability to obtain food nutrients from food for a healthy and active living (WFP, 2012).

Also, food utilization is more of habits and practices and varies greatly among households and individuals. Effective food utilization according to Bashir and Schilizzi (2013) is largely a function of household knowledge on food preservation and ability to process it, ethics of good nutrition and proper care and illness managements. Further, diets with low animal protein lacks an essential nutrient known as iron. insufficient iron content in meals causes anemic conditions, very common among majority of the rural folks when especially the right quantity is not regularly utilized in meals (Banerjee and Duflo, 2011). This means that basic knowledge on nutrition, processing and storage, water and sanitation and environmental cleanliness are necessary to ensure effective utilization of food for the right body nutrients' requirements.

According to Darfour and Rosentrater (2016), increasing food availability and food accessibility does not necessarily translate to food utilization if best practices aforementioned are not been followed. Furthermore, Ruel *et al*. (2010) indicated that undiversified meals are poor meals and poor meals are deficient in micronutrients constituting a key indicator for child stunting and detrimental to maternal nutrition.

2.5.2.4 Food Stability

This is simply the state or conditions surrounding household's food availability, accessibility and food utilizations, and its adequacy at all times regardless of the risk of being food insecure (Leroy *et al.*, 2015). Stability is simply ensuring that the three main dimensions of food security are forever functioning. World Food Programme 2018 stated that food stability is the progressive dimensions of nutrition and food security, thus the period over which food and nutrition is in existence. According to Abegaz (2017), food stability is when the other three dimensions of food security

are fulfilled at any time. This means that alleviating the three dimensions of food security at all times is necessary. Therefore, preventive measures should be put in place to eliminate factors that might adversely impose danger on availability, accessibility and utilization of food.

According to Darfour and Rosentrater (2016), over reliance on unpredictable and erratic climatic conditions, fluctuations in energy sub sector, economic and social disruption and, global markets failures constitutes major risks to food availability, accessibility and utilization. Potential measures such as agricultural sector expansion via food crops and livestock subsectors' development are deemed appropriate since both sub sectors have positive linkages to food availability (Pangaribowo *et al*., 2013).

2.6 Empirical Review of Methods, determinants of food security, and foods insecurity

Several researches in Ghana and elsewhere have used various methodologies to look into the factors that determines foods security at the national, regional, household, and individual levels.

The work of Cordero-Ahiman *et al*. (2020) investigated variables that influence foods insecurity in rural Ecuador's Paute River Basin. The study analyzed factors that determine food insecurity in the rural area of the Paute River Basin households at Azuay Province, Ecuador. Stratified sampling method was used. The study also used the Latin American and Caribbean Household Food Security Measurement Scale to measure food security. While two binomial logit models and one ordered logit model were used in estimating the determinants of household food insecurity, ordered probit model and binomial probit could have equally been used to estimate

determinants of household food insecurity as an alternative model. Also, this study was only limited to rural communities in Ecuador within the Paute river Basin so the results cannot be generalized for other parts in the country. The results showed that household size and access to food security information were the most important determinants of food insecurity.

The study by Christian *et al*. (2019) looked at association between food insecurity at the household level, dietary diversity, and mean micronutrient density adequacy for children, as well as the determinants of these indicators. The objective of this study was to examine the determinants of household food insecurity, dietary diversity, and children's mean micronutrient density adequacy and the correlation among these dietary measures. Methodologically, Baseline analysis of a quasi-experimental intervention study was conducted in twelve rural communities in the three-agro ecological zones of Ghana. The results indicated that, food insecurity was more severe among farming households than their non-farming counterparts. Dietary diversity score was significantly higher among non-farming households than farming households. Non-farmer households had a high purchasing power that enabled them to buy diversified farm food products from farming households. Food insecurity was negatively correlated with both household dietary diversity and child mean micronutrient adequacy. There existed no link between diet diversity and micronutrient density for children. Children's mean micronutrient density adequacy was significantly predicted by belonging to a highly food insecure household and household size. Also, household poverty was found to be a good predictor of reduced nutritional intake among children. The study concluded that, household food insecurity was a good indicator of lower nutrient intake in children. This study could have equally use household food consumption score to compute for the food security

level of children that could better address the dietary diversity (food access) and nutritional intake (food utilization) by children.

Study of Oyetunde *et al*. (2019) looked at technical efficiency as a critical barrier to food security. The determinants of household technical efficiency and households' food security status were assessed using the probit model. Households with access to food were more technically efficient than those without access to food. This means that access to sufficient and safe food contributes to efficient productivity since safe foods contributes to healthy workforce. This study used secondary data from the General Household Survey conducted by the National Bureau of Statistics, Nigeria without indicating which particular sampling methodology was employed.

The work of Nkomoki *et al*. (2019) identified factors linked with food security and used the Food Consumption Score and Household Hunger Scale to assess food security in Zambia. The objective was to determine factors that are associated with food security in Zambia. This study utilized household questionnaire survey datasets of four hundred smallholder farmers in four districts conducted in 2016 in southern Zambia. Concerning food security indicators, the study used two food security indicators, dubbed the food consumption score and Household hunger scale. Additionally, two ordered probit models were regressed with FCS and HHS as dependent variables. The findings for both FCS and HHS revealed that high educational level, increasing livestock income, secured land tenure systems, increased land size, and group membership increases the probability of household food and nutrition security. The results suggested that livestock development programs policies such as training of farmers in animal husbandry, as well as increasing land tenure security and empowerment for farmer groups had potentials

to promote household food and nutrition securities in Zambia. The study was limited to only two-food security indicators at the household level; meanwhile the dietary diversity score, Household Food Insecurity Access Scale and other suitable indicators could have been used to measure food security at the household level.

In addition, the study of Yousaf *et al*. (2018) used the Dietary Intake Assessment, Household Food Insecurity Access Scale, and Household Dietary Diversity Score to assess the food security situation of farmers and non-farmers rural families in Punjab, Pakistan. The main objective of this study was to examine the food security status of farmer and non-farmer rural households using the aforementioned three food security indicators. The results revealed that farmer households were better off than non-farmer households. Findings also demonstrated that the degree of food security in households differed among various strategies, despite the fact that their patterns were extremely similar and there was a substantial association between them. Similarly, the drivers of food security differed between farmer and non-farmer households, in terms of monthly income, family size, and family structure serving as shared variables for both. This means that employing one strategy does not preclude the use of the others because they all accomplish the same goal. This study was limited to evaluating the food security levels of farmers and non- farmers without necessarily looking at the determining factors of food security, meanwhile endogenous switching regression model could have been more suitable to give an estimate of the food security level, the determinants of food security for both farmers and non- farmers.

Furthermore, the work of Abegaz (2017) used pooled data from the 6th and 7th rounds of the Ethiopia Rural Household Survey and a Multivariate Model was used

to investigate food security and causes in Ethiopia. The objective was to look at food security status of households and to identify the determinants of food security in rural Ethiopia. Methodologically, the study used pooled data obtained from the 6th and 7th round of the Ethiopia Rural Household Survey. Frequency distribution tables and charts (Bar) were used to elucidate the data. In addition, binary multivariate logistic regression model was used to identify the determinants of food security. Results revealed that; majority of the households were found food insecure. Rainfall shocks, household location (region of respondents) and lack of off-farm incomes determined food security. This study was limited to only Rural Households in Ethiopia, so it is imperative that, the results of this study cannot be generalized to urban households in Ethiopia.

Codjoe *et al*. (2016) analyzed household characteristics and food diversity using bivariate and multivariate models. The average dietary diversity in households was 6.8. Vegetables were determined to have the most diversity. Dietary diversity was statistically associated with household variables like sex and education level, wealth and food sources. The study revealed that Accra's population had wide range of dietary diversity, despite low intake of foods high in micronutrients. This study relied solely on data from the 2nd round of the Regional Institute for Population Studies EDULINK urban poverty and health study.

Osman (2015) investigated the level of household food security and its causes, as well as food insecurity coping mechanisms, among farmers in the West Mamprusis and Mamprugu Moagduri districts in Ghana. This study sought to assess FS level, factors that influence household FS and coping strategies used among smallholder farm households in the aforementioned districts in North East region of Ghana.

Methodologically, Food security indicators such as Cost of Calories (COC), Households Dietary Diversity Score, and Household Food Consumption Scale were used to compute food security status. Concerning the determinants of household food security, the logit model was used while Kendall's coefficient of concordance was used to rank copping strategies used by households to mitigate the effects of food insecurity in the area. The sampling procedure and technique employed was multistage sampling approach was used. The results showed that, mean farmland sizes were 3.50 acres. Location, gender, education, and work access all had positive impacts on household foods security; the reverse is true for household size and marital status. This study found that, reducing household expenditure on food, reducing food consumption within meals; reduce frequency of meals daily and consuming less quality and relatively cheaper foods were the coping strategies adopted by households to mitigate food insecurity effects. This study was limited to food security statues and causes of food insecurity of households in two districts in the North East region of Ghana. This means that the results could only be generalized within the two districts solely.

A study conducted by Akudugu *et al*. (2012) investigated impacts of climate changes on food security and rural livelihoods in three Ghanaian regions. This study focused on how climate change affects food security and rural lives in three northern regions from an economic and socio-cultural perspective. The study found that communities who had never experienced floods or droughts before are now dealing with the consequences of these natural disasters, which are threatening food security and household livelihoods. This means that, besides climate change, various other factors, such as conflicts, poverty, and inadequate infrastructure, have an impact on food security and livelihoods. This study was limited to the impacts of climate

changes on household's food security in the then Northern region, Upper East region and Upper West region of Ghana.

In conclusion, several authors have employed varied techniques of evaluating food security, most likely based on personal preferences and study objectives. Food security at various levels have been estimated using varied methods such as the DDS, COC, HFCS, HHS, DIA, HFIAS, and HDDS. Logit models (Binomial, Ordered, Binary, Multivariate logit) and Probit models (Standard, Ordered, Bivariate logit model etc.) were used to determine determinants of food security, which included household size, access to information, locality, sex, education level, access to employment, income, family size, land tenure, farm size, and FBO membership, among others.

2.7 Empirical Review of Determinants of Farmers Participation in Agricultural Innovation

A number of studies have been carried out on the elements that influence farmer's decision to engage in or embrace an agricultural innovation (Martey *et al.*, 2014; Akpan and Udoh, 2016; Martey *et al*., 2013; Gomda (2018).

The study of Martey *et al*. (2014) investigated factors that influenced farmer engagement in multi-stakeholder platform in Ghana. This study identified the factors that influenced willingness to participate in innovation platforms as well tested the level of agreement among the identified constraints associated with participation employing the probit model and Kendall's coefficient of concordance respectively. Cross sectional data was primarily collected from 250 smallholder rice farmers in northern Ghana. The results revealed that age, household size and household income influenced willingness to participate on innovation platforms. Results obtained from

the Kendall's coefficient of concordance showed that about 21% agreement existed between the rankings of the participation constraints faced by rice farmers sampled.

The work of Wiredu *et al.* (2013) quantified factors that influenced participation in rice development projects among smallholder rice farmers in Northern Ghana. The study used a binary probit model to measure factors that influenced rice farmers' participation decision. About four hundred rice farmers were selected through multi-stage sampling approach. Participation in rice development projects in Northern Ghana was largely influenced by age, marital status, access to off-farm income, market price of rice, knowledge of rice varieties and access to credit.

The work of Akpan and Udoh (2016) also employed binary logit to investigate farmers' engagement in government agricultural programmes in a volatile political climate in South-South area of Nigeria. Farmers' participation in agricultural programmes was found to be significantly influenced by household size, dependency ratio, experience, landownership, awareness index, membership in political party, non-farm income, extension agent services, sex and education, according to the findings. Conversely, farm-income and bureaucracy were statistically insignificant.

Issahaku *et al* (2020) used endogenous switching regression model to account for selectivity bias in their study of factors that influence farmers' decisions to embrace climate-smart practices and the extent to which adoption affects food and nutrition security in Ghana. The study discovered linkages between adoption and food and nutrition security that was both positive and significant. Climate-smart adoption could reduce negative effects of climate change on food and nutrition security components.

The participation of Persons with Disabilities in agriculture and impacts of participation on food security in the then Savelugu-Nanton district were highlighted in Gomda (2018). The probit model proved effective in identifying factors that influence PWDs' participation in agriculture. Age, sex, education, household size, labor access, FBO membership, decision-making authority of households, and farm-size were all found to be significant factors of PWD' participation decision.

In conclusion, the following variables were found in literature to significantly influence participation. Age, sex, education, household size, FBO membership, farm size, marital status, political party affiliation, dependency ratio, non-farm income, extension services, land ownership and wealth of household.

CHAPTER THREE

RESEARCH METHODOLOGY

3.1 Introduction

This chapter details the various research methodologies used for the study. The section comprises of the study area, sampling procedure and technique, sample size, sources of data and data collection methods, the type of data used, research design, techniques of data analysis, the analytical framework and data presentation.

3.2 Study Area

The study was conducted in three regions of the then northern region of Ghana (Now North East region, Savanna region and Northern region). The region falls within the northern ecological zone of Ghana. Northern region (old) was the largest region and occupied about $70{,}385km^2$ of land, which accounts for about 29.5% of total land area, with an estimated population of 2,479,462. The population is mainly rural (69.7%) with the farming population making up to about 90%. This means that about 2,231,515 of the population are farmers. Major food crops mostly grown in Northern region are mainly cereal – (maize, rice, sorghum, guinea corn and millet), legumes - (groundnuts, cowpea, soya bean and Bambara beans) and vegetables- (Garden eggs, leafy melon, pepper and tomatoes) (GSS, 2013).

The region experiences one rainy season with relatively dry climate. The raining season begins in May and ends in October while the dry season starts in November and ends in March/April annually. The region's mean rainfall annually ranges between 750mms and 1050 mm. The dry season has maximum temperature record at the end of the season (March-April) and the least temperature record at the start of the season (December and January) (Abubakari *et al.*, 2017). The dry season is

characterized by harmattan winds that start from December to early February. These winds are normally warm and dry causing daily temperatures rising significantly and causing rapid soil moisture evaporation. The daily temperatures range between $33^0C\ to\ 39^0C$ while mean night temperatures range between $14^0C\ to\ 23^0C$ in December- January period. The amount of water vapor in the air (humidity) is low aggravating the effects of heat during daytime (Abubakari *et al.*, 2017; GSS, 2013). Below is a map of Ghana depicting Northern Region.

Old map of Ghana showing then Northern Region

New map of Ghana showing North East, Savanna and Northern Regions.

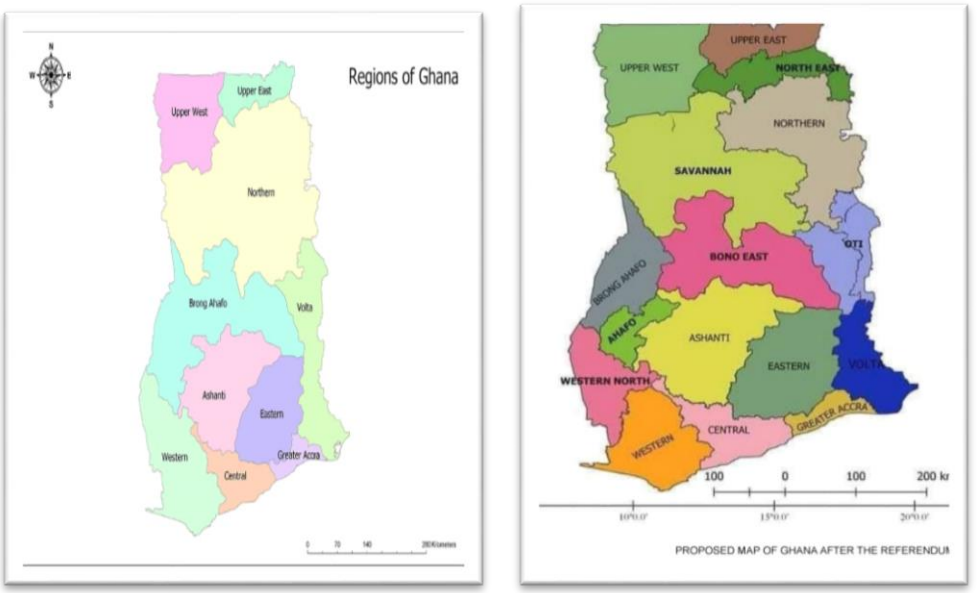

Figure 3.1: Old and New Map of Ghana depicting Northern region

Source: www.ghana tourist website.

3.3 Sampling Procedure and Techniques.

The study used probability and non-probability-sampling techniques. With probability technique, every household head farmer have a well-known (non-zero) probability of inclusion in the sampled respondents (Alvi, 2016; Etikan, 2017). This suggests that the chances of being selected in the sample is equal across all household heads in the region. The multi-stage sampling approach was used because of the large and sparsely populated nature of northern region. According to Etikan, (2017) multi-stage sampling approach is suitable when the study area is relatively large reflecting the rationality of dividing the area into equal or unequal smaller zones. The then northern region (North East, Savannah and Northern) was chosen

because of the similarities in terms of socio-economic, demographic, and ecological characteristics with emphasis on similar climatic conditions (drought, floods and topography) they have been battling with in recent times, which is directly linked to food security (Kleemann et al., 2017).

In stage one, northern region was sub divided into three clusters, namely Northern cluster, North East cluster and Savanna cluster because northern region is relatively large reflecting the need to divide into equal or unequal smaller zones. In stage two, four districts namely, Mamprugu Moaduri, West Mamprusi Municipality, Tolon and Kunbungu districts were purposively chosen from North East and Northern clusters (two districts per cluster) because of the high-level of cultivation of maize and rice food crops (Ismaila and Tanko, 2021), which are the target crops in the PFJ programme. While North Gonja district was selected purposefully from Savanna cluster because of its high level of maize, soya beans and sorghum food crops cultivation in the region. Five districts were selected for this study namely; Tolon, Kunbungu, Mamprugu Moagduri and North Gonja districts and West Mamprusi Municipality. In stage three, simple random was used in selecting ten farming communities from each district/ municipality with the help of registered community's records at the districts Ministry of Foods and Agriculture Offices.

In all, fifty farming communities were chosen for the study. The use of simple random sampling technique was also used in the fourth stage to select four PFJ participant smallholder farmers while snowball-sampling technique was used to select four non-participant farmers from each of the selected communities. This means that, eight household head farmers were selected from each community, which constituted four participants and four non- participants of PFJs Programme.

In all, four hundred respondents constituted the sample size for the study with two hundred being participants and two hundred non-participants. The derivation of the sample size for this study was supported by Yamane's (1976) formula using the prevailing population of the study area at 5% margin of error (95% confidence level).

S= $\frac{N}{1+N(\alpha)^2}$ Where N= sample population, (2,479,461) S= sample size, α= error margin (5%).

S= $\frac{2,479,461}{1+2,479,461(0.05)^2} = 399.934 \approx 400.$

Table 3.1: Generic Summary of Sampling Size.

	Sampling Size				
Zone	**Districts**	**Communities**	**Participants (4 per community)**	**Non-Participants (4 per community)**	**Total respondents per district**
North East	Tolon	10	40	40	80
	Kunbungu	10	40	40	80
	Mamprugu Moadure	10	40	40	80
	West Mamprusi	10	40	40	80
Savannah	West Gonja	10	40	40	80
Total	**5**	**50**	**200**	**200**	**400**

Source: Author, 2019.

3.4 Data Source, Data Type and Research Design

The study used primary data collected in a cross-sectional survey during the 2020 production season. Four hundred household heads were engaged in face-to-face interviews using structured questionnaires. The study employed quantitative research design. Quantitative research design comprises an array of approaches concerned with the orderly exploration of social phenomena, which uses numerical data in measuring variables (Watsan, 2014). While surveys are useful for gathering large data for describing samples and populations with a pre-established questionnaire, this study used cross-sectional survey approach with closed ended structured questionnaires that aided a successful interview for the required data for this study.

3.5 Theoretical Framework

The fundamental theory for this study is the utility maximization theory. The theory stipulates that a farmer will participate in the PFJ if the expected utility they would derive from the programme is more than the projected utility of not participating in PFJ programme (Mabe, (2018). If the study considers P^* being a concealed variable which represents the difference in utility that existed between being beneficiary of the PFJ, P_1 and otherwise, P_0 are expressed mathematically as

$$P^* = P_1 - P_0 \qquad (1)$$

Hence, by this theory, if the latent variable $P^* > 0$, farmers will prefer to participate in the PFJ interventions and if $P^* < 0$, they will not participate.

The unobserved variable P^* which gives the net utility could therefore be modeled using household head farmer-peculiar characteristics, location-specific characteristics and other socio-economic variables like age, educational status, sex etc., as;

$$P^* = \beta_i X_i + \varepsilon i \quad (2)$$

Where Xi is the set of explanatory variables, βi is the vector of parameters coefficients, and εi is stochastic error terms that accounts for unobserved variables that determines the explained variable and is presumed to have zero means and a constant variance.

3.6 Conceptual Framework

Figure 3.2 presents conceptual framework of this study. Conceptual framework involves thinking critically over an interconnected idea with causal relationships that aids the understanding and interpretation of research information (Ngulube *et al*., 2015). It guides and gives a road map to policy makers to design and execute programs on participation of agricultural interventions. Consider a farming community, where farmers live with numerous factors that are key in influencing their decision of participation or adoption of an improved agricultural technology. The conceptual framework expatiates how farmers' decisions to participate in the government planting for foods and jobs program is correlated with the possible effects from the programme on food security in northern region as shown in figure 3.2 below.

The core factors that may possibly affect participation decision of farmers in the programme are classified into household's characteristics, institutional and farm characteristics. Households' characteristics such as age of farmer, farmers' sex, farmer experience in farming, households' size, and marital status, educational level of farmers, dependency ratio and political affiliation are potential factors that may influence farmers' participation decision in PFJ.

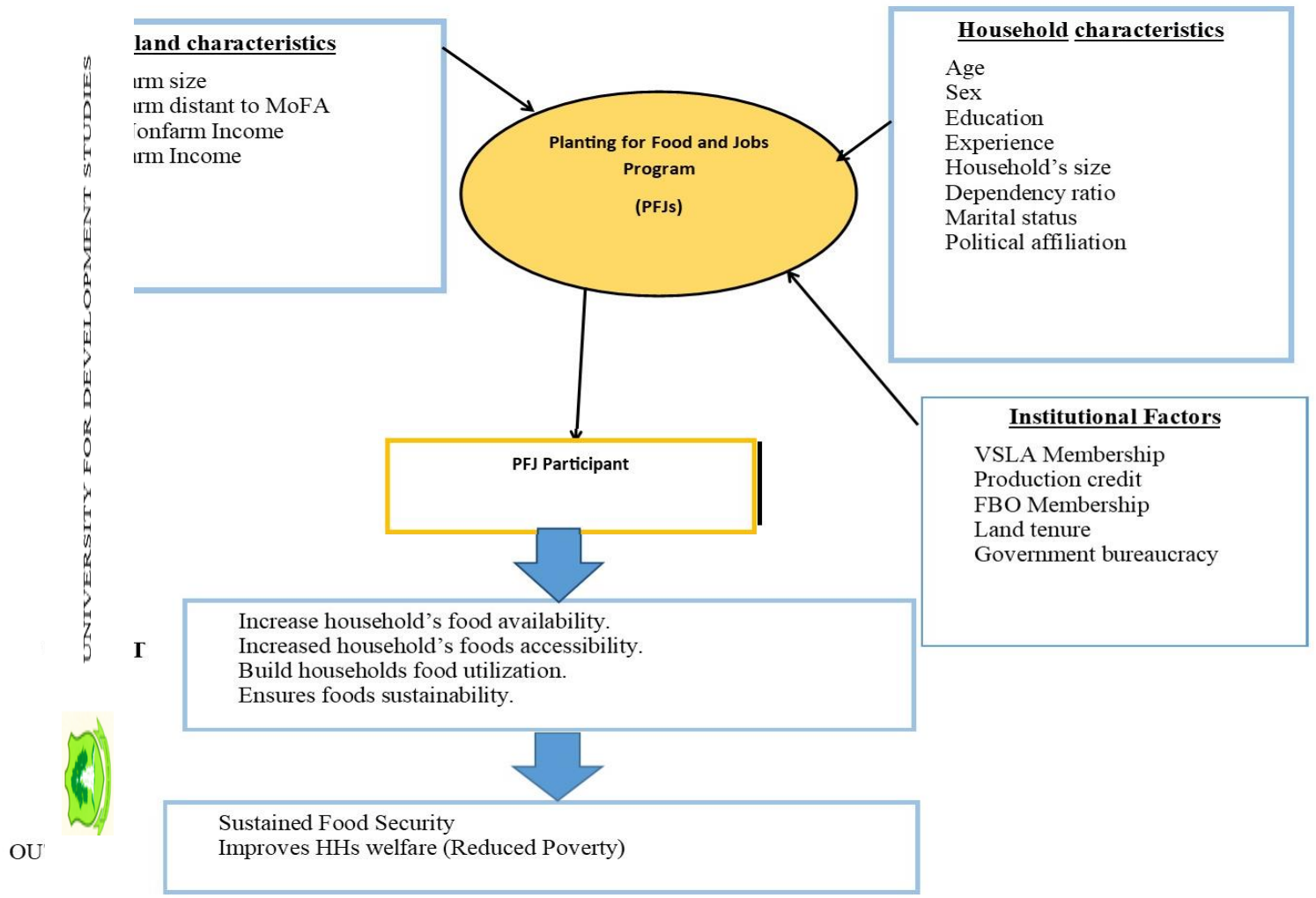

Figure 3.2 Conceptual Framework.

Source: Author's Design

The decision to participate could also solely be determined by farmland characteristics, individual household characteristics or institutional factors. The farm characteristics that could possibly influence farmers' participation decision in PFJ programme are farm size, relative location of farmers to MOFA offices (distant to MoFA office), farm income and non-farm income. Institutional factors that may also influences participation decisions of farmers to participate actively in the PFJ programme are VSLA membership, production credit, FBO membership, land tenure and government bureaucracy.

It is expected that participating in PFJ programme would increase food crop productivity because of the intensive use of fertilizer and improved seeds. This would further boost food availability, accessibility for sustained food consumption, feed for livestock subsector and raw materials for the agro industry to a point where diversification of consumer choices and food preferences at the household levels would be favored. Households' assets would equally be restored and built upon since no household would ever run shortage of consumable food. Surplus commodities would be supplied to meet demands of other consumers in both domestic and international markets.

The generated incomes of farmers from sales of surplus food staff could be used to augment household assets in the form of ruminants, poultry or could even be used to establish businesses, which could further diversify non-farm income sources.

Additionally, large volumes of surplus foodstuff, because of the programme's impact on farmers' yields in the northern region could be exported to increase the country's foreign exchange earnings. Moreover, the nutrition status and health statues would be improved among PFJ participants since there would be sufficient monies to provide balanced diet, takes care of hospital bills and the general welfare of farmers in northern region would be better off.

Conversely, it is expected intuitively that non-participating households would continue to experience low agricultural productivity, inadequate food availability, decreased access to food, decreased household's food consumption, depletion of household's assets and poor household's nutrition and health statuses. These households are most likely to be food insecure and may suffer from hunger and abject poverty.

3.7 Data Preparation and Analysis.

Prior to analyzing the data, the data was checked for multicollinearity and heteroscedasticity. The multicollinearity test results indicated that there was no collinearity between explanatory variables (See in Appendix 2, page 155). Furthermore, the heteroscedasticity test was done using Breusch-pagan/ Cook-Weisberg test. The results of this test showed insignificant (Chi2 (1) = 0.01

Prob = 0.905 (See appendix 3, page 157). Descriptive statistics like percentages and mean were used to describe the data. The determinants of participation in PFJ

programme and its contribution to food security were analyzed using the Endogenous Switching Regressions (ESR) model. Mabe (2018) outlined ten constraints that farmers identified towards PFJ participation. These constraints to PFJ participation by farmers in northern region were used for this research and were analyzed using Kendall's Coefficients of Concordances. Concerning data analysis software, STATA verse 14 and Excel were deemed appropriate.

3.8 Methodological Issues and Review

The government PFJ programme is intuitively projected to boost agricultural yields and improves household food security in northern. Per literature, many studies have keenly documented the effects of PFJ policy programmes on smallholder farmers farm productivity (e.g., Zoogah and Nakuja, 2020; Tanko *et al*., 2019a; Lambongang *et al*, 2019). While other studies focused solely on the impacts of PFJs initiative on farmer's foods security (Nurudeen, 2019). Impact assessment models have some fulfilling advantages in that impact models tries to evaluate the changes caused due to participation or adoption of certain agricultural innovations on outcome variables (e.g., yield, food security, etc.) of beneficiary farmers that would not had happened if the intervention did not exist. However, impact assessment models have some challenging issues. The challenge with impact assessment models for observational data (non-experimental) such as the data for this study is the ability to establish counterfactual situation (control group) against which the effect could be measured (Shiferaw *et al*., 2014). Thus, what would have happened if the innovation did not exist; for example, what would have been the food security of participants if they had not participated? The food security outcome of the PFJ beneficiaries if they had not participated is referred to as the counterfactual effects.

It would be biased to simply attribute the disparities in food security between the two groups to the effect of PFJ when analyzing the programmes contribution on food security. The problem with causal inference is not an issue with trial data in which the counterfactual condition is known (Galiani *et al.*, 2016; Varian, 2016). However, with cross-section surveys data, like data used in this work, where the counterfactual condition is unknown, causal inference becomes a critical consideration. According to Austin (2011), this causal inference can be resolved by assessing the differences in food security between PFJ participants and non-participants using proper econometric models to investigate the impacts of PFJ participation on foods security. For instance, models such as Rosenbaum and Rubin's (2006) propensity score-matching technique is widely used to observe impacts of agriculture technology adoption on outputs particularly when endogeneity or self-selection is a matter of concern. However, propensity score matching technique attempts to balance the observed distribution of variables among participants and non-participants. As a result, the probit or logit estimates derived in the estimation cannot be regarded as determinants of participation. Another model is Heckman's (1979) endogenous switching regression technique, which he developed, and is universally accepted as Heckman sample selection model. Addressing selectivity as an omitted variable problem, this approach may account for selection bias (Heckman, 1979). In contrast to this model, food security can be observed for both PFJ participants and non-participants. In order to capture the differential responses of these two groups, farmers are sub categorized as PFJ participants and non-participants in the switching regression approach. Given the study's interest in examining the effect of participation in PFJ on food security, it used the ESR model to account for selection biases in estimating the contribution of PFJ to food security.

3.8.1 Endogenous Switching Regression Model (ESRM) Specification

The Utility Maximization Theory (UMT) is used to model PFJ participation. The study assumed that smallholder farmers are risk adverse and that their expected utility influences their participation decision. As a result, it is assumed that the smallholder farmer will select the management option that gives the greatest benefit (Abdulai and Huffman, 2014). As expected, utilities are not observable, however participation in PFJ is observe, so the participation decision U is treated as a binary choice: U=1 if $U_1^* > U_0^*$ and U= 0 if $U_0^* > U_1^*$. Therefore, using underlying latent variables model, participation decision can be modelled as:

$$U^* = Z_\beta + \varepsilon \quad (7)$$

Where Z denotes a $n * m$ matrix of explanatory variables, $\beta = m * 1$ vector of parameters coefficients, ε vector denoting a stochastic normally distributed error terms with zero means and constant variances (σ_*^2)

Expectations are that choices of smallholder farmer to participate in the PFJ programme affects his/her household food security. With this theory, two outcome equations are modelled separately for PFJ participants and non-participants food security:

Participants: $Y_1 = X_1\beta_1 + \varepsilon_1$, if U=1 (8) Non-participant: $Y_0 = X_0\beta_0 + \varepsilon_0$, if U=0 (9)

Where Y_i with i=0 or 1 is a $n * 1$ vector of explanatory variables denoting households' food security status: Y_1 and Y_0 represents food security for PFJ programmes participants and non-participants respectively. $X_j\ is\ an\ n * k$ Matrix of independent variables and β_j is a $k * 1$ vector of parameters to be estimated. According to Puhani (2000), the selection problem arises as and when the error term

ε of selection equation correlates with the error terms e_1 and e_0 of outcome equations. In other words, if unobserved farmer characteristics, such as ability and managerial skills influence both participation and household food security, it means the estimated parameters β_j would be bias. The error terms ε, ε_1 and ε_0 are presumed to have a trivariate normal distribution with mean vector zero and the covariance matrix as shown in equation (10):

$$Cov(\varepsilon, \varepsilon_1, \varepsilon_0) = \begin{bmatrix} \sigma_c^2 & \sigma_{0c} & \sigma_{1c} \\ \sigma_{0c} & \sigma_0^2 & \sigma_{10} \\ \sigma_{1c} & \sigma_{10} & \sigma_1^2 \end{bmatrix} \quad (10)$$

Where σ_c^2 σ_0^2 σ_1^2 represents variances of sample selection equation (ε), outcome equations (ε_0, ε_1) respectively which are assumed to be 1 because the error terms can only be estimated up to a scale factor of 1. While σ_{1c} and σ_{0c} denotes the covariance between the selection equations and the outcome equation 8 and equation 9 respectively. A situation when selection bias is present, the expected values of the error terms in equations (8) and (9) are non-zero conditional on the PFJ participation, a remedy to this problematic is to find expressions for $E(\varepsilon_1 / \text{U=1})$ and $E(\varepsilon_0 / \text{U= 0})$:

$$E(\varepsilon_1/\text{U} = 1) = E(e_1/\varepsilon > -\alpha z) = \sigma_{1c}\frac{\emptyset(\alpha z)}{\varphi(\alpha z)} = \sigma_{1c}\gamma_1 \quad (11)$$

$$E(\varepsilon_0/\text{U} = 0) = E(e_0/\varepsilon > -\alpha z) = \sigma_{0c}\frac{\emptyset(\alpha z)}{1-\varphi(\alpha z)} = \sigma_{0c}\gamma_0 \quad (12)$$

This $\emptyset$ and φ represents probability density and the cumulative distribution function of the standard normal distribution respectively. Substituting $\gamma_1 = \frac{\emptyset(\alpha z)}{\varphi(\alpha z)}$ and $\gamma_0 = \frac{\emptyset(\alpha z)}{1-\varphi(\alpha z)}$, the household food security equation is re-modelled as follows (Maddala and Nimalendran, 1995).

$Y_1 = X_1\beta_1 + \sigma_{1c}\varepsilon\gamma_1 + u_1$, if U=1 (13)

$Y_0 = X_0\beta_0 + \sigma_{0c}\varepsilon\gamma_0 + u_0$, if U=0 (14)

Estimating equations (8) and (9) with ordinary least squares estimator will give biased and inconsistent parameters estimate β_j as these terms $\sigma_{0c}\varepsilon\gamma_0$ and $\sigma_{1c}\varepsilon\gamma_1$ are omitted. This occurs if and only if $\sigma_{0c}\varepsilon\gamma_0$ and $\sigma_{1c}\varepsilon\gamma_1$ takes a non-zero value.

Also, maintaining that, the variances of the error terms u_j are heteroscedastic, estimating equation (13) and (14) with ordinary least squares will be inefficient. An efficient method to address these issues, to fit the endogenous switching regression model is Full Maximum Information Likelihood (FMIL) estimator (Khonje *et al*., 2015). The FMIL method simultaneously estimates the selection and outcome equations to give consistent estimates. Nonetheless, identification of the model requires some instrumental variables, in that at least one variable in Z which is not included in X. For the model to be identified, it is important to use variables as selection instruments that directly affect the participation decision but not household food security.

This research used field school demonstration for farmers and political affiliation as the identification restriction. It hypothesized that a farmer being part of field school demonstration or political party is a proxy for a household head farmer to develop interest in participating in new policy programmes that can help them get better output and therefore might make the farmer more likely to buy into a new policy programme like PFJ programme. This hypothesis is based on the intuition that farmers who are smallholder farmers easily join political parties and agricultural related organization where ideas and innovations are shared and learned respectively. According to Di Falco *et al*. (2012), the acceptability of this instrument

is a function of performing falsification test: a variable is a valid instrument, if and only if it influences the participation decision of a farmer but do not affect the food security. The variables, field school demonstration for farmers and political party affiliation are regarded as valid selection instrument as they are statistically significant when included in an OLS regression on food security variable (See results in Table 4.12 on page 117). A sample selection bias exists when $\sigma_{0c}\varepsilon$ and $\sigma_{1c}\varepsilon$ are statistically significant, which indicate that unobserved factors, such as the managerial skills of the farmer influence the decision to participate and the food security levels of households. In this case, the endogenous switching regression is deemed most appropriate model.

3.8.2 Estimating Treatment effects on food security

As illustrated in equations (8) and (9) respectively, the endogenous switching regression model can be employed for a comparative examination of expected food security for both participants and non-participants. To calculate the expected food security in the counterfactual hypothetical instance, PFJ participants who decided not to participate and PFJ participants who choose to participate, Table 3.2 shows and defines the provisional expectations for this study outcome variable (food security) in four instances. Equations (17) and (18) indicate counterfactual expected food security, whereas equations (15) and (16) represent observed expected food security. Further understanding of these instances is supported by the definition of the variables as shown below.

$U_i = 1$ If household head farmer participated in PFJ:

$U_i = 0$ If household head farmer did not participate in PFJ:

Y_{jPFJ} = Food security of PFJ programme participants household.

Y_{jNPFJ} = Food security of non-participants households

ATT = Average treatment effect of PFJ participants' households.

ATU = Average treatment effect of PFJ Non-participants.

BH = Base heterogeneity effect of participant's households (BHPFJ) and Non-participants (BHNPFJ).

$HT = ATT$ =ATU= Transitional Heterogeneity

$$E(Y_{jPFJ} / U = 1) = X\beta_{jPFJ} + \sigma PFJ_c\gamma_{PFJ} \quad (15)$$

$$E(Y_{jNPFJ} / U = 0) = X\beta_{jNPFJ} + \sigma PFJ_c\gamma_{NPFJ} \quad (16)$$

$$E(Y_{jNPFJ} / U = 1) = X\beta_{jPFJ} + \sigma NPFJ_c\gamma_{PFJ} \quad (17)$$

$$E(Y_{jPFJ} / U = 0) = X\beta_{jNPFJ} + \sigma PFJ_c\gamma_{NPFJ} \quad (18)$$

Furthermore, if the study calculates the average treatment effects on the treated (ATT) as the difference between equations (15) and (18), as suggested by Heckman.

$$\text{ATT} = E(Y_{jPFJ} /U = 1) - E(Y_{jPFJ} /U = 0) = X(\beta_{jPFJ} - \beta_{jNPFJ}) + \sigma PFJ_c\gamma_{PFJ} \quad (19)$$

Which depicts the impacts of PFJ participations on households who took part. Similarly, the difference between equation (16) and equation (17) can be used to evaluate the average treatments effects on the untreated (ATU) for households that did not participated in PFJ programme.

$$ATU = E(Y_{jNPFJ} /U = 0) - E(Y_{jNPFJ} /U = 1) = X(\beta_{jPFJ} - \beta_{jNPFJ}) + \sigma NPFJ_c\gamma_{NPFJ} \quad (20)$$

The heterogeneity effects will be determined by the difference between equations (19) and (20). This refers to inequalities in food security that existed because of their intrinsic distinctions, such as availability and access to other ingredients, rather than

because of the PFJ. According to Carter and Milon (2005), the heterogeneity impact is the difference between equation (19) and equation (20).

$$BH_{PFJ} = E(Y_{jPFJ}|U = 1) - E(Y_{NPFJ}|U = 0) = \beta_{jPFJ}(X_{jPFJ} - X_{jNPFJ}) + (\gamma_{PFJ} - \gamma NPFJ_c)\sigma_{NPFJc}$$

(21)

Table 3.2: Estimating Treatments Effects on Food Security

Sub-sample	Decision's rule		Treatments effects
	Do participate	Do not participate	
Participants	$E(Y_{jPFJ}\|U = 1)$	$E(Y_{jPFJ}\|U = 0)$	TT
Non participants	$E(Y_{jNPFJ}\|U = 1)$	$E(Y_{jNPFJ}\|U = 0)$	TU
Transitional heterogeneity			TH

Sources: Author, 2019.

3.8.3 Analysis of Constraints Faced by PFJ Participants

The Kendall's coefficients of concordance was used to rank and examine challenges that prevent smallholder farmers from participating in PFJs programme. Friedman two-way analysis of variance, Garrett's ranking score methodology, and Kendall's coefficients of concordances are among the approaches for identifying and rating constraints of participating in a programme or project that have been acknowledged from literature. Friedman's test and Kendall's coefficient of concordance have a close link (Legendre, 2015). They attempt to address assumptions based on the same data and evaluate them using the Chi square test. Nonetheless, the style of their distinct

hypotheses differs. Unlike Friedman test, which focuses on ranked items, Kendall test hypothesis focuses on rankers (respondents) themselves.

Conversely, Garrett ranked score procedures use average ranker scores to organize them in ascending order or descending order. However, this technique has a number of drawbacks, including the fact that the level of agreement between rankers is tested. Kendall coefficients of concordance was chosen because it gives a measure of respondents' agreements, which is an advantage Kendall has over Friedman and Garrett's tests. With Kendall's, the lowest mean ranked is considered the most pressing challenge; while highest mean ranked is considered least challenged. Beneficiaries of the PFJs programme were asked to rank ten challenges in ascending order of how difficult it was for them to participate in the programme. Constraints that have been identified by farmers include; distance to registration and distribution centers, late distribution of seeds and fertilizer, unavailability of fertilizer, market challenges, inadequate extension services, inadequate harvesting equipment. Poor quality of seeds, poor quality of fertilizer, political interference and cumbersome registration process.

The total rank score calculated for each constraint are arranged in ascending order. The basis for measurement is that the ranked score calculated for each of the constraints are compared with each other. For decision-making, the challenge with the least mean value is the most pressing challenge while the challenge with highest mean value is the least constraint. The total rank score calculated serves as inputs for the computation of the coefficient of Concordance (***W***). This Kendall's coefficient of concordance **(W)** is the measuring rod to the degree of agreement among the rankings and takes values between the ranges of zero (0) to one (1). A

coefficient of Concordance **(W)** that is equal to one ***(1)*** implies the challenges ranked by a farmer are the same with challenges ranked by other farmers. In contrast, a coefficient of concordance equals to zero **(0)** means a respondent assigned ranks differs from the ranks assigned by other respondents.

The computation of the Kendall's coefficients of concordance used for (***W***) follows this formula stated below:

$$W = \frac{12\left[\sum T^2 - \frac{(\sum T)^2}{n}\right]}{n\,m^2(n^2-1)} \quad (22)$$

Where

n = number of constraints rated,

m = total sample size (farmers)

T = sum of rank of factors being ranked for each of the constraints.

W = Kendall's coefficient in a sample population

One (1) implies a strong concordance in judge's assessments; zero (0) means a lack of concordance in judge's assessments.

3.8.4 Measurements of Food Security

In measuring food security, various authors have used varied food security measuring tools to compute food security in various geographical context for diverse objectives (Mutea *et al*., 2019; Pérez-Escamilla *et al*., 2017; Ngema *et al*., 2018; Headey, 2012; Kennedy *et al*., 2010; Headey and Ecker, 2013; Tuholske *et al*., 2020; Cafiero *et al*., 2014).

According to Pérez-Escamilla *et al*. (2017), indicators for food security measurements are classified as national, household and individual levels. At national level, food security measuring tools include indicators such as the prevalence of undernourishment, Global Hunger index and Global Food Security

Index. Whereas food security at the household level, is measured using indicators such as Household Consumption and Expenditure Surveys, 24-hours recall, Dietary diversity measures, Food Consumption Score and Household Dietary Diversity Score (Pérez-Escamilla *et al*., 2017). This means that no specific accepted food security measuring tool for the measurements of food security. The choice of the measuring tool relies on the researcher and the objectives he/she intends achieving. The level is also a key factor that determines which particular food security-measuring tool to use.

The Prevalence of undernourishment is extensively used by Food and Agriculture Organization to assess Food Insecurity (Pérez-Escamilla *et al.*, 2017) while the Global Hunger Index measures and tracks hunger at global, regional and national level (IFPRI, 2016). According to Cafiero *et al.* (2014), prevalence of undernourishment focused on availability and adequate dietary energy supply relative to dietary energy requirement of average individual. This indicator is not recommended for household, in that poor food and poor data can be use, leading to unreliable information. It also takes too long to collect data. The GHI is recommended for its ability to provide results for children, meanwhile the results interpretation is extremely complex due to the term "hunger," used when indeed, child health and nutrition is the target.

In relation to measurement tools at household levels, Household Food Consumption Score and Food Dietary Diversity Score are widely used food security measurement tools, even though the author discretion and the type of data utilized determines which indicator to use. The Food and Nutrition Technical Assistance Project developed HDDS method, which is widely use to track household food access

(Cafiero *et al.*, 2014). This implies that HDDS technique tries addressing household's food access. According to Tiwari *et al*. (2013), HDDS summarizes the number of food categories eaten by an average household member over a 24-hour recall period. The HDDS assigns value to each food group (twelve food groups), that ranges from 0 to 12. This means that when households consume a food group, a value of one is assigned; otherwise, zero is assigned to that food group that such household is not privileged to consume that period.

The twelve food groups used for computing HDDS indicator are cereals, roots and tubers, vegetable, fruit, meat-poultry-and-offal, eggs, fish and sea food, pulses-legumes-and-nuts, milk and milky products, oil/fats, sugar and honey, and miscellaneous (Tiwari *et al*., 2013). This implies that any food category eaten is coded a value of one or zero otherwise. In calculating the HDDS, the total number of food groups eaten are considered which takes a value from zero to twelve (0–12) and classified into low, moderate and high food secure households using an agreed threshold.

The FCS indicator is an amalgamated score focused on dietary diversity, food frequency, and the relative nutritional importance of food eaten over seven-days recall (Tuholske *et al.*, 2020). This means that FCS is an integrated approach in measuring food security as it addresses food availability, access and food utilization dimensions. According to Leroy *et al*. (2015), the FCS takes into account three factors (Dietary Diversity, food frequency and relative nutritional value). This means that when employing the Household FCS method in measuring security of foods, the number of food categories ingested by a particular household over a seven-day recall is recorded, as well as the number of times those foods were

consumed and the nutritional values is also being considered. Focusing on the nutritional weights, food groups are weighted and sum up together to produce the Food Consumption Score (Tuholske *et al*., 2020). This suggests that food quality and adequacy of food consumed are considered.

Additionally, the selection of the food weights according to Leroy *et al*., (2015) is based on interpretation of food ‘‘nutrient density,’’ by a team of analysts who assigned higher weights to foods that contains significant energy and high quality protein with wide ranges of bioavailable micronutrients. For instance, meat-source foods and milky foods were weighted four while low weight 0.5 was assigned to oil and sugar foods. The score, which ranges from 0 to 112, is calculated by adding the weighted frequencies for the various food groups consumed by the household. According to pre-established thresholds, food security is poor when they range from zero to twenty-one, borderline when food security value is ranged from 21.5 to 35 or above 35 it is acceptable (Leroy *et al*., 2015). Based on these advantages of FCS, this research used this technique to compute for food security status of household in northern region.

Table 3.3. FCS Food groupings.

Examples of food	Groups	Weight	Justification
All grains (Maize, rice etc.), cassava, yam etc.	Cereals /Tubers	Two (2)	High-energy content, low protein, poor quality than legume and micronutrient
Leguminous foods (Beans, peas, peanuts, nuts etc.)	Pulse	Three (3)	Moderate energy content, higher protein with lower protein quality than meat
Leafy food and vegetables	Vegetables	One (1)	Lower energy content, low protein, no fats
Fruity	Fruit	One (1)	Low energy and protein, no fat, micronutrient.
Beefy, chevon, poultry, Mouton, Fishes, insects.	Meat and fish	Four (4)	Highest quality protein, easily absorbable micronutrients, energy dense etc.
Milky foods or dairy	Milky	Four (4)	Highest quality protein, micronutrients, vitamin A etc.
Sweet foods	Sugar and honey	Half (0.5)	No calorie, mostly eaten in little quantities
Oil from vegetables, butter, fatty foods etc.	Oil	Half (0.5)	Energy dense but usually no other micronutrients. Mostly consume in minor quantities
Beverages and spicy, salty, fish power etc.	condiments	Zero (0)	Eaten in minor quantities

Source: WFP(2008) Cited in (Tiwari *et al.,* 2013)

3.9 Description of Explanatory Variables.

Participation decision in PFJs programme and the household food security levels constituted the dependent variables for this research study. To explain these dependent variables, certain independent variables must be identified from literature to include in the model. These independent variables below were included in this study models as explanatory variables and how they were measured.

3.9.1 Age

Several studies have found that farmer's age plays an important role in his or her decision to participate in government policy initiatives and agricultural operations in Africa, particularly in Ghana. The age of household head affected participation significantly, according to Martey *et al*. (2014) and Gomda (2018). The age of the household head, according to Akpan and Udoh (2016), was statistically negligible, meaning insignificant. Based on these disparities, smallholder farmer's predicted sign of age could have a positive or negative impact on PFJ participation. Age was measured as a count variable as the number of years the farmer was at the time of the interview.

3.9.2 Sex of Household Head

The household heads' sex was measured as a dummy (1 if a male and 0 if female). Traditionally, the male head of a household is in charge of meeting the basic needs of the family. These responsibilities are burden for men, and they feel that agricultural advancements will enable them to relieve themselves of financial stress. Male household heads typically make household decisions, and the decision to participate in agricultural projects that come their way is no exception. Female farmers, on the other hand, are more socially networked and likely enough to have

strong relationships, regardless of tradition and cultural customs. Akpan and Udoh (2016), Gomda (2018), and Osman (2015) all found a positive relationship between sex and participation, as well as food security. Wiredu *et al*. (2013), on the other hand, discovered the opposite. As a result, sex can be either positive or negative.

3.9.3 Household Size

The number of individuals living together and eating from the same pot at the time of the survey is referred to as household. Household size was measured as the number of people in a household. Farmers' participation and food security are projected to positively influence by household size. This is because size of the household acts as a form of family labor and frequently complements the efforts of the household's head on the farm. According to Wiredu *et al*. (2013), the availability of family labor allows the home head to share responsibilities while also freeing up time for other development initiatives. Household size is key for a household to engage in a policy programme, and it is predicted to have a positive impact on participation and food security.

3.9.4 Marital Status

Household food security and participation are heavily influenced by marital status. The variable was measured as a dummy (1= married, 0 =otherwise). Wiredu *et al.* (2013) discovered that rice farmers' engagement in rice improvement programmes was influenced by their marital status. Married household heads are more stable, and unlike unmarried household heads, they do not migrate to the south on a seasonal basis. As a result, they have a high level of policy participation ability. Furthermore, because married households are responsible for a significant number of family members, any policy intervention introduced in the community would be welcomed.

However, Akpan and Udoh (2016) discovered that farmers' marital status had no influence on their desire to participate in government agricultural programmes. The status of one's marriage might be either positive or negative.

3.9.5 Education

Education level of a household head is continuous and was measured in years of formal education. Household head education is a social asset that is defined as the number of years spent in formal education by a household head. Farmers with a higher educational level are more likely to participate. The findings of Ntshangase *et al*. (2018); Aydogan *et al*. (2021); Suvedi *et al.* (2017); Akpan and Udoh (2016), discovered that an increase in farmers' education level improves the likelihood of participation. Other studies however found contradictory results, which indicated that, staying in school for an extra year diminishes a farmer's chances of participating in an agricultural project by around 2% (Wiredu *et al*., 2013). This may result in making the indicator influencing the dependent variable positively or negative.

3.9.6 Household's Head Experience in farming

Farming experience is continuous and computed in the number of years in farming. Farmers who are in the field of farming for longer period have higher probability of participation in government agricultural programmes (Akpan and Udoh, 2016; Martey *et al*., 2013). The work of Nahayo *et al.* (2017) who found that farm experience negatively influenced participation in crop intensification programme in Rwanda. Therefore, experience is expected to influence farmer's participation in PFJ programme positively or negatively.

3.9.7 Household head Political affiliation

This variable is binary; (1= ruling NPP, 0=Otherwise).The household political party affiliation is to find out whether the participation in the PFJs programme are the ruling New Patriotic party (NPP) members or otherwise. Akpan and Udoh (2016) found that ten percent increase in farmers' political affiliation increases the probability of farmers' participation. The expected sign is positive.

3.9.8 Farm Size

Farm size is continuous, measured in acres. Size of a farm is the total land area under cultivation during the last cultivating season by households. The larger the farm size, the higher the expected level of food production likewise participation. Martey *et al*. (2013) confided positive correlation between farm size and households heads participation. The size of the farm is an alternative way of determining the level of farm commercialization, therefore, farmers are usually motivated to participates in projects so as to get access to farm inputs, smart technologies and markets for products (Akpan and Udoh, 2016). However, Martey *et al*. (2013); Wiredu *et al*. (2013) reported a statistically insignificant relationship between farm size and household head participation. Hence, the expected effect is either positive or negative.

3.9.9 Nonfarm Income

This is continuous and was measured in Ghana cedis. This refers to any other sources of income earnings accrued to the household's heads outside the farm. Income earned from other livelihood source either than farming is expected to influence participation and food security negatively or positively. Household head that earns nonfarm income may not have enough time to participate in any agricultural

programme probably due to competing opportunity costs. However, earnings from the nonfarm activities may be ploughed back in adopting improved inputs in order to increase production. Martey *et al*. (2014); Akpan and Udoh,(2016) all confided that nonfarm income of households heads positively influenced participation.

3.9.10 Household's heads access to extension services

This is continuous variable and was measured as the number of times an extension officer visited to household head farmer. Availability of extension services and frequent visits by extension agents increases the technical expertise among farmers. The expectation is that agricultural extension services positively influences farmers' decision to participate in PFJ programme. Martey *et al*. (2013); Wiredu *et al*. (2013); Akpan and Udoh (2016) revealed that a farmer who gets access to quality agricultural extension services had better chances of participation in an agricultural projects. The frequent visit by high-class officers is a source of motivation to farmers to produce more food due to participation in government agricultural programmes. The expected sign of this variable is positive**.**

3.9.11 Households heads Access to Production credits

Production credit refers to funds loaned to farmers for agriculture investment purposes. Farmers may decide to access loans from relatives, market women, banks or microfinance institutions to support farm activities. This is dummy (1=Access to production credit, 0=No access to production credit). The availability and accessibility of production credit is an opportunity for farmers to improve farm output/yields as well as been able to mitigate their financial barriers to participating in an agricultural intervention. Household's head ability to access production credit is a pre-requirement for expansion of farm inputs. Martey *et al.* (2013) and Wiredu

et al. (2013) indicated that the probability of participation by household heads that got access to production credit showed statistical significance. Therefore, the expected is that farmers' access to credit influences their participation and food security positively.

3.9.12 FBO Membership

This variable was measured as a dummy; (1=Yes; 0 =No). The farmer-based organization (FBO) membership tells whether the household head farmer belongs to any farmer base group in the community or not. Farmer Based Organization serves as a common platform for dissemination of crucial information-by-information agent. Members easily have access to information pertaining to the development of their communities and mostly do many things in common towards achievement of a common goal. Many farmer-based groups engage in group marketing of farm products, collective purchasing of farm inputs as well as credit provision for its members. Akpan and Udoh (2016) stated that Farmer Based Organization influence individual farmer's participation positively. However Martey *et al.* (2014) found otherwise. This could have negative or positive influence on participation**.**

3.9.13 Land Ownership

Land tenure was measured as a dummy; (1= owned land; 0= otherwise). Land is a crucial conventional input in agriculture production and is a pre requisite for participation. Land is a fix asset and has several competitive uses among rural farmers. Financial institutions in the rural communities' uses land as a major collateral requirement for farmer access to agricultural purpose loans. The availability of land is indirectly and positively influences farmer participation in agricultural projects (Martey *et al.*, 2014 Akpan and Udoh, 2016). However, Wiredu

et al. (2013) found a statistically insignificant relation. Therefore, it is expected that land ownership will have positive influence participation and food security**.**

3.9.14 Distance to MOFA Office

This is also a continuous, measured in kilometers. The distance between the household heads residence/farm and the ministry of food and agriculture office serves as an additional cost that may hinder willingness to participation. Household heads that are distant away from the MoFA office may not find it easy participating in the Planting for Foods and Jobs programme interventions, more particularly when they lack means of movements (Martey *et al.*, 2014). This may influence participation positively.

3.9.15 Village Savings and Loans Association Membership (VSLA M)

The VSLA membership of farmers was measured as a dummy variable (1= member; 0= not a member). The VSLA is usually un-registered group of farmers who agreed to pool their monies into a fund where they can access loans to each other with interest for a period of time (preferably one year) (Karakara *et al*., 2021). Members borrowing and repayment of loans with interest increases the group funds. VSLA improves FS, enhances agricultural production and productivity through increased volume of savings (Dagunga *et al*., 2020). This is because the chances of farmers getting a loan for agricultural investment is high. The participation decision and food security of farmers may have a positive relation with VSLA.

3.9.16 Dependency Ratio (DR)

This is the total household members within the age group of 0-19 and 65+ divided by total number of active labor force who work to cater for the entire household. DR compares the ratio of youth (0-19 years) and the elderly (65+ years) to the number

of those within the working-age group (19-64 group). Literature revealed that, fewer dependents are more food secure than large dependents' in Southeastern Nigeria (Iheoma, 2020). The expected effect of dependency ratio on food security is negative or positive and positive for participation into the PFJ programme.

3.9.17 Farmer Field School Demonstration

The farm field school demonstration was measured as a dummy variable (1= participated; 0= not participated). Farmer Field School is an educational approach for capacity building among farmers that helps them to analyze their production systems and identify problems on the farm. According to Ayi (2022) farmer field school effectively increased the knowledge of participants and influenced technologies adoption among farmers of about 71%. This can influence participation decision of farmers positively.

3.9.18 Farm Income

Farm income is a continuous variable. This was measured in Ghana cedis. Money earned to the farmer from previous years farm output was computed. Kan *et al.*, (2006) found that farm output (income) affects participation positively. Below in Table 3.4 is a variable description, measurement and a priori expectations.

Table 3.4: Variable Description, Measurement and Apriori Expectation.

Name of Variable	Description	Measurement	Expectation
Age	Age	Count in years	+/-
Sex	Sex	(1 if male, 0 if female)	+/-
Marital Status	Marital status	(1 if married and 0 otherwise)	+/-
*Edu*cation	Level of education	Years for formal education	+/-
Household size	House hold size	Count (number of people in household)	+/-
Farm Experience	Farm experience	Years in farming	+
Farm size	Farm size	Acres	+/-
Farmer Based Organization	Member of FBO	Dummy (1 if yes, 0 if no)	+
Political Affiliation	Political affiliation	Dummy (1 if NPP, 0 otherwise)	+
Non-farm Income	Non-farm income	Non-farm income in Ghana cedis	+/-
Production Credit	Production credit	Dummy (1 if Yes, 0 if No)	+
Land Ownership	Land ownership	1 if own land and 0 otherwise	+
Distance to MOFA Office	Distance to MOFA office	Kilometers	+/-
Farm income	Farmer's farm income	Income from fam in Ghana Cedis	+/-
Village Savings Loans Association	VSLA Membership	Dummy (1 if yes, 0 otherwise)	+/-
Farmer Field School Demonstration	Farm Sch field demonstration.	Dummy (1 if yes, 0 otherwise)	-
Dependency Ratio	Dependent ratio	(0-19yrs + above 65yrs)/ (Active labor force).	+/-

Source: Author, 2019.

CHAPTER FOUR

RESULTS AND DISCUSSIONS.

4.1 Scope of the Chapter

This chapter presents results and discussions of findings of this study. The first part presents the descriptive statistics of socio-economic and demographic characteristics of sampled respondents. The second section presents discussions on the empirical estimates from ESR Model on the factors influencing farmers' participation decision in PFJs Programme as well as factors that determine households' food security, the average treatment effects on households' food security and discussions on the Kendall's Coefficient of Concordance results.

4.2 Descriptive Statistics of Continuous Variables

Table 4.1 presents the summary statistics for continuous variables used in this study. T-test was performed to determine if there is any statistically significant difference between continuous variables belonging to PFJ participants and non-participant households. On average, the age gap between PFJ participants and non-participants was statistically insignificant. The standard deviations showed that the age variations among participants and non-participants farmers were 11 and 13 years, respectively. This means that farmer's ages are heterogeneously distributed in the study area. The ages of both participants and non-participant farmers indicate that majority of the respondents were within active labor force range (19-64 years).

A significant difference was observed in educational attainment between PFJ participants and non-participant farmer. Participant farmer had an average of 4 years of formal education, compared to 2 years of formal education for non-participant farmer. The results show that on average, level of education of farmers was basic.

On average, the difference in household size between participants and non-participants in the PFJ was statistically insignificant. PFJ participants' households have an average household size of 11 people, whereas non-participants' households have an average household size of 12 people. This is above the average household size of five persons in a household of the three regions.

In terms of respondents' dependency ratio, there exist a statistically significant difference between participants average dependency ratio of 0.44 and non-participants farmers' average dependency ratio of 0.40.

The average farm experience of PFJ participants and non-participants differs by 4 years and is significant at 1%. These results indicate that non-participant farmers in the PFJ have four years of agricultural experience than PFJ participants. Farmers who are in the field of farming for longer period have higher probability of participation in government agricultural programmes (Akpan and Udoh, 2016).

Concerning respondents' farm income and non- farm income, the PFJ participant and non-participant household head farmers' average farm income and average non-farm income were statistically and significantly different. Participant farmers' average farm income and non-farm income were GH₵757.05 and GH₵ 367.15, respectively higher than their counterparts.

Table. 4.1: Summary Statistics - Continuous variables.

Variable	PFJ Participant		Non-Participant		Difference	t (values)
	Means	Sd	Means	Sd		
Age	38.3	11.40	37.32	12.67	-0.69	-0.57
Education (years)	3.61	5.09	1.78	3.59	1.83	-4.16***
House hold size	11.44	5.48	11.86	5.70	0.42	0.76
Dependency Ratio	0.44	0.16	0.40	0.15	-0.03	-2.11**
Farm Experience	15.00	9	19	12	4	3.89***
Household farm income (GH₵)	3602	2320	2845	2715	-757.05	-2.99***
Household non-farm income	822	1239	454.33	950.09	-367.15	-3.33***
Total Farm size	9.83	4.74	7.43	6.26	-2.39	-4.30***
Rice farm size	3.04	2.69	1.46	2.05	-1.59	-6.65***
Maize farm size	3.66	2.38	2.21	2.03	1.45	-6.54***
Soya beans farm size	0.43	1.13	0.46	0.98	0.03	0.30
Rice farm output (100kg)	19.41	19.05	7.93	11.63	-11.48	-8.38***
Maize output (100kg)	21.41	15.37	10.75	10.91	-10.66	-8.00***
Soya Beans output (100kg bags)	1.71	0.36	1.68	0.31	-0.02	-0.05
Dist. to MoFA office (Km)	13.95	6.83	13.93	6.83	-0.02	-0.02

Source: Field Survey, 2020

This means that the PFJs programme benefited farmers in northern region, most likely because of increased use of enhanced inputs. The significant standard

deviations of roughly GH₵ 2,320 and GH₵2715, respectively, demonstrated a wide variation of farm and non-farm income distribution in northern region.

The average total farm size as well as the average farm size of rice and maize were 2.39 acres, 1.59 acres and 1.45 acres respectively and was statistically significant. The size of the farm is an alternative way of determining the level of farm commercialization, therefore, farmers are usually motivated to participates in projects so as to get access to farm inputs, smart technologies and markets for products (Akpan and Udoh, 2016).

Furthermore, there was statistically significant difference in rice output. On the average, a difference of 11 bags of rice existed between PFJ participant farmers and non-participant farmers. This suggests that household head farmers who benefited from the programme had higher rice yields, most likely because of the intensive improved seeds usage and timely fertilizer application. Individual farmer output variations were about 19 bags and 12 bags of rice for PFJ participation and non-participant farmer respectively.

Similarly, average maize output differed significantly by 10 bags and was statistically significant at 1%. The difference in average soya output was statistically negligible. This suggest that both participant farmers and non-participants farmers' soya outputs were the same. The distance from farmers residence to MoFA Office, the difference in distance traveled (kilometers) was statistically negligible. The distance traveled by a household head to MoFA's office is about 14 kilometers for both farmer categories. This is intuitively right, because both farmer categories live in the same geographical area and are within the same driving distance to the district capitals where the MoFA offices are located.

4.3 Descriptive Statistics of Discrete Variables

Table. 4.2 presents descriptive statistics of discrete variables of sampled respondents. The results revealed that male farmers constituted the majority with 85% and 86% of the participant and non-participant farmers respectively. The percentage difference that existed between male farmers who are PFJs participants and non-participant was insignificant. This is consistent with Akpan and Udoh (2016) who showed a positive link between participation and male composition.

The results showed that, eighty-eight percent (88%) of non-participants were married, while 82% of PFJ participants were married. There was a significant difference between the percentage of marriage between the participants and non-participants. PFJ participant farmer access to production credit for agricultural purposes was also statistically different from non-participant farmer access to production credit. According to the findings, about 36% of participant farmers had access to production credit, while 21% of non-participant farmers accessed production credits. The difference was statistically significant at 1%. This means that majority of PFJ participant farmers accessed production credits for agricultural uses in northern region.

In terms of political affiliation, 63% of PFJ participants household heads were members of the ruling New Patriotic Party (NPP), whereas 24% of non-participant household head farmers were members of other political parties in the country. The difference in percentage between participant farmers and non-participant farmers in terms of political affiliations was significant at 1%. This implies that majority of farmers who belong to the ruling party were PFJ members. Furthermore, there was a significant difference in percentage of literacy among participants and non-

participants. The results in Table 4.2 shows that 36% of participant farmers were literate, while just 18% of non-participant farmers were literates.

Concerning Village Savings and Loans Association (VSLA) membership, about 33% of participant farmers belonged to Village Savings and Loans Association whereas about 17% of non-participant farmers were actively involved in the Villages Saving and Loan Association. The percentage difference between the participants and non-participant who were members of VSLA members was statistically significant at 1%.

Lastly, about 33% of participant farmers had participated in field school demonstration while only 4% of their counterparts had field demonstration experiences. The average percentage difference between PFJ participant farmer and non-participant farmer was statistically significant. This means that farmers who have higher frequency of school field demonstration were PFJ participants while farmers with little or no single field demonstration experience did not participated in the Planting for Foods and Jobs Programme.

Table. 4.2: Descriptive Statistics -Discrete Variables

Variables	PFJ Participant		Non-participant		Dif.	t-values
	Mean	Std. dev.	Mean	Std. dev.		
Sex	0.85	0.35	0.86	0.344	0.01	0.35
Marital Status	0.82	0.39	0.88	0.33	0.062	1.73*
Production Credit	0.36	0.48	0.21	0.41	-0.15	- 3.34***
Political Affiliation	0.63	0.79	0.24	0.03	-0.39	-6.18***
Literacy	0.36	0.48	0.18	0.39	-0.18	-4.22** *
VSLA	0.33	0.47	0.17	0.37	-0.17	-3.88***
Field Sch. Demons	0.33	0.37	0.04	0.2	-0.29	-7.97***

Source: Field Survey, 2020.

4.4 Farm Size Distribution of Household

Table 4.3 below presents the average farm size distribution of sampled households' heads across participants and non-participants in district specific. In the pooled sample, the average farm size was about 8.6 acres. The average farm size of farmers in Tolon district formed the largest farm size with 9.6 acres, while farmers from Kumbungu district had the least land size of about 7.9 acres. In relation to programme participant and non-participant the results show that majority of all districts' participant respondents' farm sizes were larger than farm size of non-participant farmers. The farm size of participant farmers in the study area was about 9.8 acres while the non-participant farmer's farm size was on average 7.4 acres. The results further showed that the distribution of farmland among participant farmers

was evenly distributed compared to farmland distribution among non-participant farmers across northern region. This is shown by the estimated standard deviations for both category where participant farmers had a relatively smaller standard deviation (4.7 acres) reflecting smaller variations compared to non-participant farmer's standard deviation (6.3 acres) depicting relatively larger variations among farmers.

Test of validity of significance on average farm size variations was done between participants and non-participants using two-sample t test with unequal variances. This test validates if there exist any significant difference between the average farm size of farmers who are programme participants and farmers who are not. The t-test showed statistically significant results at 1%.

Table 4.3 Average Farm size of Household Heads

District	Participant	Non- Participant	Pooled
Kunbungu	8.94	6.76	7.85
Mamprugu Moaduri	9.95	7.54	8.46
North Gonja	8.9	7.45	8.17
Tolon	10.78	8.36	9.63
West Mamprusi Municipal	10.63	7.04	9.11
Grand Total	9.83	7.44	8.64
Standard errors	4.74	6.26	5.67
	t-test	Significant	Mean diff.
	-4.31	0.00	2.39

Source: Field Survey, 2020.

This means that there exists a significant difference between average farm sizes of participants and non-participant farmers in northern region of Ghana. These results suggest that farmers participating in the Planting for Foods and Jobs Programme used larger farmland than farmers who are not. This could be attributed to the increased access to and utilization of subsidized improved farm inputs such as seeds and fertilizers.

4.5 Farmland Acquisition and Ownership

Table 4.4 presents the percentage distribution of household heads' mode of farmland acquisition and land ownership. Land is a very crucial conventional input in the production of food, which has several competing uses among farmers. The results revealed that majority (80%) of sampled farmers inherited farmlands from their family members.

Table 4.4 Household Heads land acquisition and Land Ownership.

Mode of land Acquisition	Frequency	Percentage
Inheritance	320	80
Buying	20	5
Gift	48	12
Inheritance and buying	8	2
Inheritance and gift	4	1
Total	**400**	**100%**

Source: Field Survey, 2020.

Furthermore, 1% of farmers acquired farmlands through inheritance and gifts. While 5% of farmers bought farmlands for agricultural purposes in northern region. This flexible mode in land acquisition for agricultural purposes in the area allowed many household heads to invest in farming business. Also 2% of farmers acquire farmlands through inheritance and buying and 12% of farmers acquired lands as gifts.

4.2.5 Percentage Distribution of Household Heads Livelihoods

Table 4.5 presents the percentage distribution of primary and secondary livelihoods of household's heads for participants and non-participants. The results revealed that majority (71%) of farmers relied solely on agriculture for living. In comparism, the percentage (71%) of participant farmers marginally differed from the number (70.5%) of non-participant farmers by one person. Meanwhile 29% of them had secondary livelihood besides farming for the pooled sampled. The results further showed that, 29% of PFJ participant farmers had at least one secondary livelihood in addition to farming, which was marginally less than the percentage (29.5%) of the non-participant farmers. These secondary livelihoods include hunting (14%), building technology (Mason) (10%), electrical engineering (3%), carpentry (6%), tractor operator (8%) and local circumcision (6 %|) (Wanzam). Majority (53%) of the farmers who had secondary livelihood were traders, who traded in second hand clothes, raw food stuffs business, food vendors, agro chemicals dealers, fish smokers and provisions stall proprietorships etc. In comparism, except for hunting and carpentering livelihood of PFJ participant farmers, where the percentage of farmers 15% and 9% respectively were higher than the percentages of the non-participants farmers. The percentages of the rest were lower than the percentages of non-

participant farmers. This could mean that majority of non-participant farmer's prioritized limited time in doing secondary livelihoods.

Table 4.5 Percentage distribution of Household Primary and Secondary Livelihoods

Livelihood	Participants		Non-Participants		Pooled Sample	
	Frequency	Percentage	Frequency	Percentage	Frequency	Percentage
Primary	142	71	141	70.50	283	71
Secondary	58	29	59	29.50	117	29
Total	**200**	**100**	**200**	**100**	**400**	**100**

Secondary Livelihoods

	Participants		Non-Participants		Pooled Sample	
Secondary	Frequency	Percentage	Frequency	Percentage	Frequency	Percentage
Trading	30	51	32	54	62	53
Electricals	1	2	3	5	4	3
Mason	5	9	7	12	12	10
Hunting	9	15	7	12	16	14
Carpentering	5	9	2	4	7	6
Tractoring	4	7	5	8	9	8
Wanzam	4	7	3	5	7	6
Total	**58**	**100**	**59**	**100**	**117**	**100**

Source: Field Data, 2020.

4.2.6 Distribution of Non-Farm Income

Table 4.6 presents the average and percentage distribution of non-farm income in three folds: they include incomes of participant farmers, non-participant farmers and the pooled sample respectively. On average, participant household head farmer earned about GH₵ 819.2 with a standard deviation of about GH₵1242.48. This showed heterogeneity of non- farm income distribution among participant famers in northern region. Non-participant farmer and full sampled respondents earned about GH₵460.29 and GH₵ 639.75 respectively. Meanwhile, individual non- farm incomes of non-participants, pooled sample and participants significantly varied of about GH₵ 950.15, GH₵1119.145 to GH₵1242.478 respectively. In contrast, the average non-farm income of participant farmers almost doubled that of the non-farm income of non-Participant farmers.

Table 4.6. Average and percentage Distribution of Non-farm income.

Income (GHS)	***Participants (n=200)***		***Non-participants (n=200)***		***Pooled (N=400)***	
	Percentage	Mean Income	Percentage	Mean Income	Percentage	Mean Income
0 – 1,000	75.50	323.64	85.50	150.51	80.5	231.70
1001 -2000	17.50	1578.85	9.00	1451.00	13.25	1535.66
2001 –3000	3.50	2608.57	2.00	2475.00	2.75	2560
3001 -4000	1.00	3800	2.50	3608.00	1.75	3662.86
4001 -5000	0.50	5000	0.50	4800.00	0.5	4900.00
5001 -6000	0.50	6000	0.00	0.00	0.25	6000
6001 -7000	0.50	6700	0.00	0.00	0.25	6700
7001 -8000	0.50	8000	0.50	7200.00	0.5	7600
8001 -9000	0.50	8400	0.00	0.00	0.25	8400
Totals (Pooled)	**100**	**819.2**	**100**	**460.29**	**100**	**639.75**
Std. Dev.		**1242.478**		**950.1476**		**1119.145**
T test						

Source: Field Data, 2020

Averagely, participant farmers earned GH₵358.91 more than non-participant farmers. This means that an amount, equivalent to GH₵358.91 would have been lost if participant farmers had not participated in the PFJs Programme.

The highest non-farm income earned by participant and non-participant farmers was about GH₵8400 and GH₵7200.00 respectively whereas the lowest was GH₵ 323.64 and GH₵150.51 respectively. This is an indication that the Planting for Foods and Jobs programme interventions are bettering farmers' welfare through increased non-farm incomes in the northern region, when all other factors are held constant.

In relation to income classification of the household's heads across participants, non-participant farmers and the pooled sample, the results showed that majority of smallholder farmers earned non-farm incomes within the income group of GH₵ (0 – 1,000). About 75.5%, 85.5% and 80.50% of the participant farmers, non-participant farmer and pooled households head farmers earned non- farm income within the income range of GHS₵0.00 and GHS₵1000 respectively. The minimum average non-farm income was about GH₵ 150.51, GH₵231.70 and GH₵323.64 for non-participant farmers, pooled and participant farmers respectively. Further, about 0.50% and 0.25% of the participant and pooled farmers respectively earned the maximum income of about GH₵8400.00 while about 0.50% of the non- participant farmers earned a maximum income of about GH₵ 7200. Thus, the average non- farm income of participant farmers almost doubled non-participant farmers.

4.2.7 District Specific Distribution of Non-Farm Income

Table 4.7 presents the districts level non-farm income distribution among non-farm income of participants, non-participants and the pooled sample. West Mamprusi Municipality's participant farmers earned the maximum average non-farm-incomes of about GH₵ 1177.75, which was slightly higher than the average non-farm income of Tolon district participant farmers. All districts average non-farm-incomes of farmers who participated were higher than the average non-farm income of farmers who decided not to participate in the programme with a difference of about GH₵4.25. While Participant farmers in Mamprugu Moaduri district earned the minimum average non- farm income of about GH₵407.75, non- participant farmers from North Gonja district earned a minimum average non- farm income of about GH₵ 60.00. The maximum average non- farm income was about GH₵ 768.25 for farmers in Kumbungu district.

In summary, the average non- farm income of participant farmers almost doubled non-participant farmers. This implies that the Government Planting for Foods and Jobs programme interventions may be improving farmers' welfare through increased incomes in northern region, holding all other factors constant and assuming both farmers practice similar agronomic practices.

Table 4.7. District Specific Distribution of Non-farm income.

Non-farm Income	*Participants (n=200)*		*Non-participants (n=200)*		*Pooled (N=400))*	
District	Percentage	Mean Income	Percentage	Mean Income	Percentage	Mean Income
MMD	20	407.75	20	542	20	474.875
WMM	20	1177.75	20	328.75	20	753.25
TD	20	1173.5	20	596.2	20	884.85
KBUNGD	20	794.75	20	768.25	20	781.5
NGJD	20	548.25	20	60	20	304.25
Total (Pooled)	**100**	**820.4**	**100**	**459.04**	**100**	**639.75**

Source: Field Data, 2020.

4.2.8 Comparative Statistics of PFJ Targeted Food Crops Output Between Participants and Non-participants.

Table 4.8. Presents summary statistics of PFJ targeted food crops grown by household head farmers, which includes rice, maize, Soya beans and guinea corn. The results showed that the average output of participant farmers were more than non- participant famers. Participants' farmers had a minimum farm output of about 1 bag of rice, 3 bags of maize and 1 bag of soya beans and maximum output of about 100 bags of rice, 80 bags of maize and 30 bags of soya beans. While non-participant farmers' minimum outputs was maize (0), rice (3) and soya beans (0) and maximum was maize (51), rice (42) and soya beans (40). The difference observed in minimum and maximum outputs of non-participant farmers could be attributed to non-use of improved inputs coupled with drought, floods and bush fires.

In relation to farmers' population in each category, presented in Table 4.8. The majority of 70% and 91% were rice and maize farmers respectively who participated compared to 43% and 71% of rice and maize farmers who did not participated in PFJs programme. From the results, it can be deduced that the PFJs programme has increased population of rice and maize farmers in northern region by 63% and 28% respectively. Conversely, the percentage of soya beans farmers who participated were less than the percentage of soya beans farmers who did not participate. As revealed in the Table 4.8, about 48% of Soya bean farmers did not participate in the programme while 28% of soya beans farmers were beneficiaries of the programme. This could mean that farmers converted their previous soya beans scarce lands and other resources to cultivation of staple food crops like maize, mostly used for staple meals like 'Tuo-zaafi'.

Regarding farm sizes and outputs, rice farmers who participated had both farm size and outputs greater than rice farmers who did not participate in the programme. The results revealed that average farm size and outputs of rice farmers who participated were 4.32 and 27.52 respectively. Compared to an average of 3.46 and 18.97 in farm size and output of rice farmers respectively who did not participate. This means that, participant rice farmers had about 0.86 acres and 8.55 bags respectively more than the average farm size and outputs of rice farmers who did not participate in the programme. However, variations were observed in farm size across individual farmers' farm size, which varied by 2.17 and 1.76 acres respectively. Similarly, the variations in rice output across individual rice farmers (participant and non-participants) varied with mean output of 17.05 bags and 10.97 bags respectively. The average farm size for participant maize farmers was slightly higher (1.01 acres)

than non-participant maize farmers and deviated from the mean farm size by 2.24 and 1.62 acres for participant and non-participant farmers respectively.

Tabl ummary Statistics of PFJs Targeted Crops Cultivated.

Cro	arm tegory	Frequency		Mean Scores		Standard Deviation		Minimum - Maximum	
	rget tegory	Ps (N=200)	Non-Ps (N=200)	Ps	Non- P	Ps	Non- Ps	Ps	Non-Ps
Rice	e (dummy	140	86	0.70	0.43	0.457	0.50	0 - 1	0 - 1
	rm size(acres)			4.32	3.46	2.167	1.76	0 - 1	1 - 9
	tput			27.52	18.97	17.052	10.97	1 - 100	3 - 42
Mai	ize ummy)	182	142	0.91	0.71	0.287	0.45	0 - 1	0 - 1
	m size(acres)			4.06	3.05	2.235	1.62	1 - 18	1 - 11
	m output(bags)			23.81	14.825	14.625	9.60	3 - 80	0 - 51
Soy	va (dummy)	28	48	0.14	0.24	0.348	0.42	0 - 1	0 - 1
Bea	m e(acres)			2.79	2.04	1.287	1.12	1 - 5	1 - 5
	tput(bags)			10.69	7.53	8.183	6.86	1 - 30	0 - 40
		N= 200	**N= 200**						

Source: **Field Data, 2020.**

NB; Ps =Participants, NPs =non-Participants.

Average participant output was about 8.99 bags more than non-participant maize farmer. The variations per individual maize farmer output from the average outputs for both participant and non- participant farmer was heterogeneously distributed with varying quantities of about 14.63 and 9.60 outputs respectively. For soya beans, the average farm size and output of participant farmers were also more than non-participant farmers even though percentage of participant farmers were less. Participant farmers were able to increase output probably because of the increased use of improved inputs supported by PFJs programme. On average, Participant's farmers had 0.75 acres and 3.16 bags of soya beans more, than non- participant farmers. The quantity of soya beans farm outputs per individual farmers differs from mean output by 8.18 and 6.86 bags for participants and non-participants respectively.

4.2.9 Comparative Statistics of Other Crops Cultivated

Table 4.9 presents the summary statistics of other food crops cultivated by farmers in the study area. Other food crops grown by household head farmers include guinea corn, beans, Tubers (yam, cassava and sweet potato), vegetables (okro, alefu, bito, tomatoes) and groundnuts. As indicated in Table 4.9, About 6%, 20%, 3% 32% and 28% of participant farmers cultivated guinea corn, beans, yam vegetables and groundnuts respectively. In relation to non-participants of the programme, the percentage was marginally higher for crops such as guinea corn, beans and yam. The results showed that about 9%, 5% and 6% of non-participants farmers cultivated guinea corn, beans and yam respectively. This could be attributed to the guaranteed market incentive for PFJ promoted food crops (maize, rice and soya). However, the percentage of vegetables and groundnuts production for farmers who did not

participate in the programme were relatively lower than farmers who participated in the programme.

PFJ impact on farm size was positive. In contrast, the average farm size and output for all other crops were lower for non-participant farmers when compared to the average farm size and output of the PFJ programme participant farmers. An average farm size of 4 acres produced farm output of 18.2 bags. Whilst non-participating farmers used about 3.94, acres to produce an average output of 14.8 bags for all other crops. On average, non-participants lost about 3.4 bags for not participating into the PFJs Programme.

Tabl mmary Statistics of Other Food Crops Grown.

Crop	Category	Frequency		Mean Scores		Standard Deviation		Minimum - Maximum	
	Category	Ps	Non- Ps	Ps	Non-Ps	Ps	Non- Ps	Ps	Non-Ps
Guinea Corn		11	17	0.055	0.085	0.229	0.279	0 - 1	0 - 1
Beans		40	9	0.2	0.045	0.401	0.207	0 - 1	0 - 1
Yam		6	32	0.03	0.16	0.171	0.3675	0 - 1	0 - 1
Vegetables		64	53	0.32	0.265	0.468	0.442	0 - 1	0 - 1
Ground nuts		56	54	0.28	0.27	0.450	0.445	0 - 1	0 - 1
All other crops	ze(acres)			3.990	3.938	2.223	3.580	1 - 11	0.5 - 22
	bags)			18.19	14.778	12.400	17.06	1 64	0.25 - 140
		N=200	**N=200**						

Source: Field Data, 2020.

NB; Ps =Participants, NPs =non-Participants

4.3.1 Determinants of participation in PFJ in Northern Region of Ghana.

The estimated parameters (coefficients) with robust standard errors obtained from the Endogenous Switching Regression Model (ESRM) is presented in Table 4.10 below. The ESRM simultaneously estimated the determinants of participant's household food security and non-participants households' food security in the northern region. The Wald chi square of interdependence was insignificant, which showed that the three equations (the two outcome equations and the selection equation could have been estimated separately). Likewise, the Rho_1 and Rho_2 showed that, there was no selection bias; hence, OLS could have also been used, however the ESRM was used because of its ability to account for both observed and unobserved food security. Individual household heads' characteristics (age, education and farm experience), farm-characteristics (farm income and non-farm income), and institutional-factors such as land ownership, household head farming field school demonstration and political affiliation of farmers were significant determinants that influences household head farmers participation decision the PFJ.

The results showed that age was significant at 1%. This means that if a farmer gets older by one year, his probability of participation in PFJs programme increases, when all other factors are held constant. This is consistent with Gomda (2018) who found that farmer's age plays an important role in his or her decision to participate in government agricultural policy initiatives. According to Gomda (2018), age determined Persons with Disability participation in agriculture positively, indicating that older disabled farmers were more likely to be participants in agriculture compared with young farmers. However, the findings were contradictory to the work of Martey *et al.* (2014). According to Martey *et al.*, (2014), the age of respondent was significantly correlated with a lower probability of participation in Multi-

Stakeholder Platforms (MSP) in northern Ghana, indicating that the probability of participation in MSP decreases for every additional year added to the age of the household head. According to his study, younger household heads farmers were more willing to participate on the platform than older household heads.

The results further showed that the education of the household head had a positive impact on PFJ participation and was significant at 1%. This implies that if farmer stays in school for one more year, his or her chances of participating in the PFJ increases, holding all other conditions constant. This finding are in consonance with the findings of Ntshangase *et al.* (2018) Aydogan *et al.* (2021); Suvedi *et al.* (2017) Akpan and Udoh (2016), who discovered that an increase in farmers' education level improves the likelihood of participation. For instance, farmer years of formal education positively influenced adoption of no-till Conservation Agriculture at 5% significance level (Ntshangase *et al.,* 2018). According to him, an additional year of education a farmer attained, correlates with adopting no-till Conservation Agriculture positively. This is because farmers view education as an integrated tool for analyzing choices and making decisions about anticipated benefit forecasts for adopting innovations. However, this contradicts Wiredu *et al*. (2013), who found that if a farmer continues school for an additional year, the chance of participating in an agricultural project decreases marginally.

The results also showed a negative relationship between farm experience and participation in the PFJs programme in northern region. Farm experience was significant at 1%. A possible explanation of this contradiction can be attributed to the fact that the PFJ was initiated to eliminate youth unemployment hence the youth who actively participated in PFJ were mostly inexperience in farming. This result is

inconsistent with Akpan and Udoh (2016) who confided that farmers who are in the field of farming for many years have higher probability of participating in government agricultural programmes.

Household land ownership was positively correlated with PFJ participation in northern region and was significant at 5%. This showed that an increase in ownership of farmland increases the probability of farmer's participation in PFJs programme. This is consistent with Akpan and Udoh (2016) who found that, ownership of farm land positively influences participation in agricultural programmes. According to Akpan and Udoh (2016) farmers decision to participate in any agricultural based programme, depends on an increase in land ownership among farmers. Land ownership will probably reduce the cost of production and expands profit's level. 'Ceteris paribus'. However, Martey *et al.* (2014) found a statistically insignificant relationship between land ownership and willingness to participation in multi-stakeholder platforms in Northern Ghana. This study authenticates the a priori expectation set, that land ownership positively influences PFJ participation in the northern region.

Similarly, this study found that the relationship between household head farm income and probability of participation is positively significant at 10%. According to the results, an increase in farm income of household farmer head by GH₵1, will increases the likelihood of participation in PFJs programmes, holding other factors constant. This is consistent with Kan *et al.*(2006) who found that farm output (income) affects participation positively. According to him, farm income (output) have positive effects on participation (market). This implies that the propensity to consume partly of farm income (output) is less than unity

Nonfarm income of household head farmer influences participation positively and was significant at 1%. This shows that if a farmer non-farm income increases by GH₵1, his or her probability of participation increases, holding other factors constant. Farmers who have diversified sources of non-farm income that consistently augments their non- farm incomes have higher probability of participating in the PFJ programme in northern region of Ghana. The earnings of such nonfarm activities may be ploughed back in adopting improved input varieties in order to increase production. Martey *et al.* (2014) and Akpan and Udoh (2016) all confided that nonfarm income of households heads positively influenced participation.

The study also found a positive link between household head field demonstration and the probability of participating in PFJ. The number of times a household head farmer partakes in farmer field demonstration influences farmer's decision of participating in PFJ in northern region. This is statistically significant at 1 %. When household head increases the frequency of farm field demonstration by a unit, the probability of participation in PFJs programme increases, ceteris paribus. This finding is consistent with the work of Ayi (2022) who found that, farmer field school effectively increased the knowledge of participants and influenced technologies adoption among farmers.

In relation to political affiliations of farmers, the study found a positive significant relationship between household head farmer political affiliation and the probability of participation in the PFJ programme in the study area, at 1% of significance. Per the findings of this study, farmers who are members of the ruling New Patriotic Party (NPP) had high probability of participation than farmers who were not. The result indicates political affiliation of household head farmer have a positive relationship

with the probability of participation when other factors are held constant. This is consistent with the findings of Akpan and Udoh (2016) who found that political affiliation of farmers increases the probability of participation.

Table 4.10 Determinants of participation in PFJs Programme in Northern Region.

Variable	Determinants of Participation Coefficient	(Robust Std. Error)
Age	0.029***	(0.009)
Sex	0. 040	(0. 241)
Household size	-0.020	(0.014)
Education (Years)	0.048**	(0.021)
Marital status	-0.138	(0. 234)
Farm Experience	-0.041***	(0.010)
Dependency ratio	0.551	(0.482)
VSLA	0. .284	(0. 194)
Farm size	0.013	(0.022)
Land Ownership	0.550**	(0.271)
FBO Membership	0.203	(0.170)
Production Credit (Dummy)	0.185	(0.176)
Farm income	0.175*	(0.100)
Nonfarm Income	0.100***	(0.025)
Farmer Field School	1.331***	(0.246)
Political affiliation	0.654 ***	(0.139)
Distance to MoFA	-0.010	(0.012)
Constant	-3.340***	(0.770)
/Ins 1	1.326***	(0.020)
/ Ins 1	1.347***	(0.011)
/r1	-0.200	(0.223)
/r2	-0.032	(0.288)

Sigma_1	3.765	(0.076)
Sigma_1	3.844	(0.043)
Wald test of indep. eqn:	chi2(1) = 0.82	Prob > chi2 = 0.306
Rho_1	-0.198	0.215
Rho_2	-0.032	0.288
log pseudo likelihood	-1283.299	
num of observations	400	
Wald chi2 (15)	93.320	
Probability > chi2	0.000	

Source: Author's ESRM Estimates, 2020.

4.3.2 Determinants of Food Security in Northern Region.

Table 4.11 presents explanatory variables that influences the food security of households who participated in PFJs programme and determinants of household food security of farmers who did not participate in the programme. The influencing variables that affect participants food security positively were; dependency ratio, Village Savings and loans Association (VSLA) membership, farm size, FBO membership and non-farm income. The study also found that level of education and farm experience of household head farmer negatively affects food security. In relation to the food security of non-participants, production credit influenced food security negatively as the only determining variable.

The parameter coefficient of household head education was significant and negatively influenced food security of farmers who are beneficiaries of PFJs programme. This means that when household head's education level increases by one, food security reduces or is most likely to be food insecure, holding all other

factors constant. This results are consistent with Yusuf *et al.* (2015). According to his findings, when a farmer increases his year of education by one, instead of working on his farms, it the possibility of being vulnerable to food insecurity is high. The findings of this study is also consistent with Djangmah (2016) who found food security to be decreasing with increasing number of years in education in the northern region of Ghana and Nigeria respectively. Also, the finding agrees with Iram and Butt (2004) who found that higher educated farmers were negatively associated with food production in Iran. However, this finding is inconsistent with Bulawayo *et al*. (2019); Nkomoki *et al*. (2019); Codjoe *et al*. (2016) who found that education increases household's food security.

The coefficient of household head experience showed negative relationship though statistically significant at 1%. This implies that holding all other factors constant, when years of experience increases by one, food security status of the household decreases. One major objective of the PFJ programme was to reduce unemployment among the youth hence farmers that are more unexperienced had the opportunity of participation in PFJ than the experience farmers did. This result also justify that inexperienced farmers are anticipated to be food insecure due to their inability to produce more outputs compared to experienced farmers. The finding of the study fails to agree with the finding of Beyene *et al*. (2010).

Dependency ratio is significant at 1% and positively affects food security of farmers who are beneficiaries to PFJ programme. This is intuitively inconsistent since high dependency will mean high competition for domestic resources including food. This implies that as households' dependency increases, food security increases. This agrees with the findings of Ajaero (2017); Oluoko (2006) who all revealed that

dependency ratio positively influences food security, however the findings are inconsistent with Anila (2011); Akukwe (2020) and Djangmah (2016) who found that households with high dependents are likely to be food insecure than a household with lower dependents.

The estimated coefficient for households' head membership in Village Savings and Loans Association positively contributes to food security and is significant at 1%. The results showed that, farmers who belong to village savings and loans association for savings purposes are 1.44 food secure higher than farmers who are not members of the village savings and loans association. This implies that when a households' head belongs to VSLA groups, the level of food security gets better than if they had not belong to VSLA. This is intuitively consistent. Availability and access to finance (money) increases households head food purchasing power, since they probably overcome financial barriers to accessing food and non-food needs. This also is in agreement with the work of Awiti (2013) who found that Village Savings and loans associations (VSLAs) have enhanced food security.

The estimated coefficient of farm size is positive and influenced household's food security and was significant at 1%. This implies when household farmer head increases his farm size by an acre, the availability (food security) of food for household consumption increases. This is intuitively consistent as large farm holders produce more food than smallholder farmer, ceteris paribus. The size of the farm is an alternative way of determining the level of farm commercialization therefore farmers are usually motivated to participate to increase access to farm inputs like technology among others to increased output (Akpan and Udoh, 2016).

This is consistent with Kassie *et al*. (2012), that food security increases with increasing farm size.

Household head FBO membership correlates positively with food security at 10% significance. This implies that as households' heads belong to Farmer Based Organizations, food security increases than if they had not been members, holding all other factors equal. The result implied that, FBO farmers' food security status was 1.082 higher than non-FBO members. This is consistent with Nkomoki *et al*. (2019) who revealed that a farmer FBO membership increases the probability of increasing household food security. Farmer Based Organization serves as a common platform for dissemination of crucial information-by-information agent. Members easily have access to information pertaining to the development of their communities and mostly do many things in common towards achieving a common goal. Many farmer-based groups engage in group marketing of farm products, collective purchasing of farm inputs as well as credit provision for its members.

The coefficient of non-farm income was positively significant at 1%. This means that food security of household increases with increasing level of non-farm incomes ceteris paribus. Non-farm-incomes (monthly salary, income from sales of livestock, wages) has remained an essential factor that influences food accessibility. This agrees with the work of Djangmah (2016). This means that an individual household with a preferable non-farm income is likely to be better off in terms of food security than a lower income household earner. This is also consistent with the work of Osman (2015) where non-farm income via employment significantly influence household food security.

In relation to determining factors of food security for farmers who do not benefit from PFJs programme, the estimated coefficient of production credit was negative but significant at 10%. This implies that, household farmer who accessed production credit for agricultural purposes had low food security status than farmers who did not access production credit for farming by 1.434. The result means that, access to production credit worsens the food security level of famer household than if they had not have access to production credit, when other factors are held constant. This implies that there exist an inverse relationship between food security and production credit, because non-participant household head access to production credit, decreases household food security (becomes food insecure). This is intuitively inconsistent. The availability and access to production credits are opportunities for improving farm output/yields as well as been able to mitigate financial barriers to inputs and food purchases. Household's head's ability to access production credits is a pre-requirement for expansion of farm inputs to enhance farm outputs to increase food availability and access. This finding contradicts Adugna *et al* (2012) who found that access to production inputs/credits improves household food security.

Table 4.11 Determinants of Participant and Non-Participant FS

Variable	(Participants) Determinants Coefficients.	(Robust Std. Error)	(Non-Participants) Determinants Coefficients.	(Robust Std. Error)
Age	0.019	(0.037)	0.015	(0.031)
Sex	0.060	(0.966)	0.491	(1.139)
Household size	-0.048	(0.057)	-0.032	(0.053)
Education (Years)	-0.145*	(0.068)	0.013	(0.105)
Marital status	-0.645	(0.795)	-1.122	(0.965)
Farm Experience	-0.106***	(0.038)	-0.025	(0.037)
Dependency ratio	4.161***	(1.544)	-0.697	(1.913)
VSLA	1.441***	(0.564)	1.317	(0.905)
Farm size	0.177***	(0 .057)	-0.031	(0.053)
Land Ownership	-0.019	(1.281)	0.266	(0.790)
FBO Membership	1.082*	(0.621)	-0.541	(0.666)
Production Credit (Dummy)	-1.159	(0.655)	-1.434*	(0.809)
Farm income	-0.484	(0.395)	0 .367	(0.328)
Nonfarm Income	0.329 ***	(0.110)	0.005	(0.119)
Constants	14.092***	(3.855)	10.947***	(2.581)
Wald Test of Indep. eqn:	chi2(1) = 0.82		Prob > chi2 = 0.365	
Rho_1	-0.198	0.215		
Rho_2	-0.032	0.288		
Log pseudo likelihood21	-1283.299			
Number of observations	400			
Wald chi2 (19)	93.320			
Probability > chi2	0.000			

Source: Author's ESRM Estimates, 2020. ***(*) and (***) denote 10% and (1%) significant levels respectively.***

4.3.3 Test for Validity of Instrumental Variables

The application of the maximum likelihood estimator necessitated the use of instrumental variables in addition to correction for selection bias due to endogeneity. As a result, at least one variable should influence farmers' decision in the PFJ programme, but has no influence on household food security. This research used field school demonstration and political affiliation as the identification restriction. It hypothesized that a farmer being part of field school demonstration or political party is a proxy for a farmer to develop interest in participating in new policy that can help them get better output and therefore might induce the farmer to buy into a new policy. This hypothesis is based on the intuition that smallholder farmers easily join political parties and agricultural related organization where ideas and innovations are shared and learned respectively. According to Di Falco *et al*. (2012), the acceptability of this instrument is a function of performing falsification test: a variable is a valid instrument, if and only if it influences the participation decision of a farmer but do not affect food security. These variables were put to the test for validity. Simple Ordinary Least Squares (OLS) regression on food security (outcome equations) for both participants and non-participants was ran separately against the instruments in order to test instrument validity. Another requirement is that a binary logit/ probit is regressed on participation (PFJ participation) against the instruments to see if they influenced farmer participation.

Results of the instrumental variables validity test are shown in Table 4.12. Both instrument coefficients met the aforementioned conditions, according to the results. The coefficients of the outcome equations (food security of participants and non-participants) are statistically insignificant. The results for the logit regression, on the other hand, were statistically significant at 1%, indicating that both instruments had

some influence on farmers' PFJ participation decisions, but none on household food security in the northern region. This indicates that both instruments were valid.

Table 4.12 Validity of Instrumental variables.

Instrument/Joint	Non-participants (200)		Participants (200)		Pooled (400)	
	Coefficients	Stds Errors	Coefficients	Std Errors	Coefficients	Std Errors
Farm Field Demon	-0.827	(1.356)	1.076	(0.686)	2.485***	(0.385)
Political Affiliation	0.259	(0.654)	0.320	(0.408)	1.346***	(0.230)
Joint	F (2, 197) = 0.27		F (2, 197) = 1.41		LR chi2(2) = 101.86***	

Please note: (***) and denotes (1%) significant levels.

4.3.4 PFJ Programme Contribution to Households' Foods Security

Assessing effects of PFJ programme on household's food security for participants and non-participants as proxy for food security in northern region is illustrated in Table 4.13. The results showed that on average, the food security of households who were participants and decided to remain as participants was approximately 14.71 than households who were non-participants and decided to remain as non-participants with approximately 12.37. Examining the average food security of participants who chose not to participate was approximately 11.96 and non-participants who chose to participate had about 13.51 food secured.

Closely examining the average treatment effects on the treated (ATT), i.e., the difference in the average food security of participants who remained as participants (Observed group) and average food security of participants who chose not to participate (Counterfactual) was approximately 3 (i.e., 14.71-11.96= 2.75). On the other hand, the average treatment effect on the untreated (ATTU), thus, the difference in food security of non-participants who chose to participate (counterfactual) and the average food security of non-participants who remained non-participants (Observed group) was approximately 1 (i.e., 13.51-12.37=1.14). The transitional heterogeneity, which is the difference between ATT and ATTU, was approximately 2. (i.e. 2.75 - 1.14= 1.61) which was statistically significant at 1% per the t-test results shown in Table 4.13. This means, there was an effect of PFJs programme on food security of households who participated into the programme. In other words, households whose heads participated in PFJ Programme had moderately good food security, as they remained participants than their counterparts.

For effective policy implementation implication, the t-test results showed an overall positive contribution of the PFJ programme on participants food security. Thus, the ATT, ATTU and heterogeneity effect were all positive and increasing implying that those farmers who participated in PFJ programme are better off and had the opportunity to increase food security, as they remained participants than those farmers who did not participate and the counterfactual.

Table 4.13 Analysis of Treatment Effects on Food Security

Sample	Participation Decision		Treatment Effects	% Change	Transitional Heterogeneity (ATT-ATTU)
	Participate	Not Participate			
Participator	14.71 (0.118)	11.96 (0.134)	2.75 (0.183)	23%	
Non-Participator	13.51 (0.131)	12.37 (0.061)	1.14(0.121)	9.22%	1.62 (0.165)
T test (ATT-ATTU)					1.62 (0.165) ***

Source: Field Data, 2020.

4.3.5 Small Holder Farmer PFJ Participation Constraints

Table 4.14 presents the results for farmers' constraints analysis. Late distribution of fertilizer to access points was the most pressing constraint identified. Household heads are rational and would always want to maximize output per unit cost incurred in acquiring scarce inputs say fertilizer. In order to get the maximum output, farmers must follow the standard prescribed agronomic farm practices, such as timely application of fertilizer immediately after tilling farmland, sowing among others. If fertilizer input is not available at the time that it is most needed, its unavailability could affect farmers' yields negatively. According to Mabe (2018), timely release of inputs to access points is critical and should be made available all year round. This

conforms with the findings of Munkaila *et al*. (2019) who found that majority of the farmers are challenged with limited access to fertilizers and late deliveries of inputs among others which in effect limit farmers potentials to realize maximum farm outputs.

The second most pressing challenge according to the study was the distance to registration centers and distribution points. Majority (85%) of the communities in the sample were farther away from the district capitals where the registrations of farmers take place. On average, a famer had to travel a distance of approximately 14km to a nearby district capital to access programme interventions such as subsidized fertilizer, improved seeds among others. This distant journey travelled increased the cost of acquiring the inputs, which affected most farmer's participation in the programme. According to Mabe, (2018a) the distribution and sale of the subsidized inputs should be the responsibility of the private sector. This could make the inputs available to farmers in their various communities. The long-distance travelled by farmers to make payments at the banks before getting access to subsidized inputs would be eliminated. This will ease farmer's struggles in their attempts to participate in the programme.

The third ranked constraint was unavailability of fertilizer. The availability of the fertilizer is key in its accessibility. In most cases, the subsidized fertilizer is not adequate to meet the large volume demands of millions of smallholder farmers in the region. The availability of subsidized fertilizer under PFJ programme is very poor, hence affects it accessibility of fertilizer especially the time that it is most needed for application. According to Lambongang *et al.* (2019) farmers are

challenged with limited access to fertilizer which in effect limit farmers potentials to realize maximum farm outputs.

Cumbersome registration process was ranked as the fourth challenge to PFJ programme participation in northern region. The registration of farmers was considered cumbersome because farmers first had to write their names at one point in time, mostly done at the district's capitals, which required the collection of coupons awaiting the collection of the inputs at a different scheduled date. From the field interactions with most of the farmers, a farmer could travel to the district offices severally in order to get registered likewise the collection of the input. This made the acquisition of the inputs rather more costly due to frequent travels to and back from point of registrations.

Marketing was identified as the fifth challenge. Farmers were not happy with the relatively low prices of their farm products over the years. Market for the farm products was a challenge to farmers in the region. The only guaranteed market comes from the community businesspersons who buy in smaller quantities to meet the demand of the local consumers in the local markets, which most of the time are saturated, resulting in lower prices for goods. Good markets for farm products yield better returns on farm investments, which is not readily available for smallholder farmers.

Political biasness was ranked sixth. The distribution and accessibility of the inputs in northern region had political interference. If a farmer is non-member of the ruling NPP Party, then his/her chances of accessing the inputs was very low. This suggest that, members of the ruling New Patriotic Party could easily have access to the inputs since the stakeholders involved in the registrations and distributions of the inputs

were mostly party members who knows better the farmers who were NPP supporters in the various communities.

The seventh pressing challenge was inadequate extension services. Majority (76%) of farmers never had the services of any technical officer for good agronomic practices' admonishments. According to Mabe (2018a) extension services delivery has been low due to inadequate professional Agricultural Extension Agents and inadequate logistics to facilitate personnel movements to field. This affects outreach negatively leaving majority of farmers not benefiting the services of the agents in the area.

The eighth challenge was poor quality seeds. Farmers reported that, the seed inputs offered by the programme were not of standard quality when compared with the open market inputs, even though subsidized inputs were less costly especially the improved seeds under the programme. The use of grains from previous farming season is dominant among farmers in the area as perfect substitute.

Poor quality of fertilizer was ranked ninth. The quality of the subsidized fertilizer under the programme according to the farmers was not a major challenge. The quality of this input served the purpose of which it was used.

The tenth ranked challenge was inadequate harvesting equipment. Farmers in northern region considered inadequate harvesting equipment for harvesting of bumper yields as the least challenge in PFJ participation. This is because majority of farmers were smallholder farmers, who did not require much capital-intensive equipment to harvest. Farmers felt that engaging the services of capital-intensive

equipment would add some additional cost to their production cost, which sometimes disfavor farmers in northern region.

The mean score ranks of these challenges are confirmed by the computed Kendall's Coefficient of concordance (W), which revealed that about 13% degree of agreement existed among the rankers' judgments. The Chi Square was about 466.798 and was significant at 1% justifying why the null hypothesis that there is no agreement among the ranker's judgment should be rejected and that there was some degree of agreement between the ranker's judgments.

Table 4.14: Households Head Ranked Constraints.

PFJs Participation Constraints	Mean Score	Rank
Late distribution of fertilizer	3.55	1
Distance travelled to registration and distribution points	4.07	2
Unavailability of fertilizer	5.14	3
Cumbersome registration process	5.32	4
Market Challenges	5.37	5
Political interference	5.51	6
Inadequate extension services	6.16	7
Poor quality of seeds	6.38	8
Poor quality of fertilizer	6.39	9
Inadequate harvesting equipment to facilitate bumper yields harvest	7.13	10
Number of observations	400	
Kendall's W	0.130	
Chi-Square	466.798	
Asymp. Sig	0.000	

Source: Field Data, 2020.

CHAPTER FIVE

SUMMARY CONCLUSION AND RECOMMENDATIONS.

5.1 Introduction

The overview and conclusions of the study's major findings are presented in this chapter. The findings of the study were used to derive and suggest policy recommendations. The chapter's concluding part outlines some prospective future research areas/topics.

5.2 Summary of Findings

Using cross-sectional data for the 2020 agricultural season, the study assessed impacts of the PFJ programme on households' foods security in northern region. This study used structured questionnaires to obtain data from four hundred farmers from five districts in northern region of Ghana (West Mamprusis municipality, Mamprugu Moaduri, Kumbungu, Tolon, and North Gonja districts).

The average age of household head respondent was about 38 years, indicating a reasonably active labor force in the region, according to the summary statistics of continuous variables. The area's active labor force represents a potential opportunity and regional strengths that are ideal for accomplishing the PFJ aim and target objectives.

The average years of education for respondents was approximately three (3) years, indicating low level of education in northern region of Ghana. The average level of education for PFJ participants' farmers was statistically and substantially greater than for non-participants.

In terms of sex distribution among the sampled respondents, male farmers constituted majority of about 86% in northern region while female farmers constituted about 14% of the total respondents. This demonstrated how imbalanced the PFJ programme was regarding women participation in the programme.

The average size of a farm in the area was about 9 acres, with a standard variation of approximately 6 acres. It was observed that PFJ participants had greater access to agricultural farmland than non-participants because of increased access and use of subsidized enhanced agriculture inputs such as seeds and fertilizers.

The PFJ programme is a good initiative for the rural poor farmer especially those who could not afford to buy improved seeds and fertilizer at open market prices. The programme has increased the number of rice and maize farmers in the study area by 63% and 28% respectively. Even though there was a reduction in population of soya beans farmer in the study area of about 42%, there was equally an improvement in the average farm size and average output for rice, maize and soya beans farmers. Rice farmers average land size and average output were 0.86 acres and 8.55 bags than non- participant rice farmers. Average participant output was about 8.99 bags more than non-participant maize farmers. For soya beans, participant farmers were able to increase output because of the increased use of improved inputs supported by PFJs programme. On average, participant farmers had 0.75 acres and 3.16 bags more than non- participant farmers. PFJs contribution to food security started from its ability to motivate farmers especially the youth into the cultivation of food crops such as rice and maize. The increased use of improved seeds and fertilizer resulted in increased crop output, consequently increasing availability of foods in the area.

In northern region, land acquisition and ownership of valuable farmlands for agricultural activities were extremely flexible; about 80% of the sample obtained and owned farmlands through inheritance whereas 12% of the sampled respondents got farmlands through gifts, 1% obtained farmlands through both inheritance and gifts. However, about 5% of respondents purchased their productive farmlands while only 2% of them acquired farmlands through both purchase and inheritance.

According to the findings, farming was the primary income source for the inhabitants in northern region. Around 71% of household head farmers relied solely on farming (rain-fed agriculture); while 29% had at least one of the following livelihoods in addition to farming: hunting, building technology (Mason), electrical engineering, trade and commerce, Carpentry, tractor operatorship, and local circumciser (Wanzam). Lastly, traders accounted for about 52% of respondents who had additional livelihoods to farming.

Non-farm income of the pooled sampled was on average GH 639.75, which is relatively lower than PFJ participant farmer of about (GH 819.2) but relatively higher than the non-participant farmer income of about GH 460.29.

Furthermore, age, level of education, farm income, land ownership, household head farmer field school demonstration, and farmer political affiliation positively influenced farmers PFJs participation decision. While farm experience had a negative correlation with participation,

Dependency ratio, Village Savings and Loans Association, farm size, membership in a Farmer-Based Organization (FBO), and non-farm income positively determines food security. Years of education had a negative impact on food security. For non-

participant household food security, access to production credit was significant determinant.

The average treatment effect on the treated was about 3 times, whiles the average treatment effect on the untreated was about 1. According to the t-test result in Table 4.13, the transitional heterogeneity, or the difference between ATT and ATTU, was about 2 (i.e., 2.75 - 1.14= 1.61), which was statistically significant at 1%. This indicates that households' heads who participated in the PFJ Programme had moderately better food security than their peers because they remained participants.

The most pressing challenge to participation was late fertilizer provision to the point of access, whereas the least challenging challenge was insufficient harvesting equipment to permit bumper output harvest. The rankings were confirmed by the calculated Kendall Coefficient of concordance (W), which indicated that there was a 13% degree of agreement between the rankers' opinions. The Chi Square was 466.798 and was significant at 1%, indicating that the null hypothesis of no agreement among the rankers' judgments should be rejected and that there was some degree of agreement.

5.3 Conclusions

To examine the contribution of the PFJ Programme on household food security in northern region, this research relied on primary data that was directly sourced from the field during the 2020 agricultural season.

From the findings of this study, it can be concluded that: the decision of farmers to participate in PFJ in Northern region, North East region and Savanna region was largely determined positively by age, education, farm experience, land ownership,

non-farm income, production credit, farm income, farmer field school, and political affiliation, while farm experience influenced participation decision of farmers negatively.

Secondly, the effect of PFJ programme participation on household food security was positive. The observed group (PFJ participants) was more food secure than the counterfactual group, whereas the non-participant counterfactual group was more food secure than the observed group. The average treatment effect on the treated was roughly 2 times greater than the average treatment effect on the untreated.

Lastly, the most pressing problem ranked by farmers that hindered PFJ participation was late fertilizer provision to access points, while the least problem was inadequate harvesting equipment to promote bumper harvests. The Kendall's results showed that there was degree of agreement among the rankers' judgments.

5.4 Recommendations

Based on the findings of this study, the study recommends that;

Government PFJ programme should target landowners and as well work with non-governmental organizations to promote farmer field demonstrations as a strategic project scale-up technique to involve additional farmers, as this is a key factor in promoting farmer engagement in agricultural-related activities.

The Ministry of Food and Agriculture should allocate sufficient resources both human and capital to strengthen PFJ programme implementation to sustain the tremendous positive contribution to household food security in Northern region.

The government through the Ministry of Agriculture should ensure that the subsidized fertilizer under the PFJ Programme is made available in the early stages of production season for farmers to access fertilizer input to avoid late application on food crops.

5.5 Limitations and Suggestions for Future Researches.

1. The study focused on smallholder farmer households' food security in northern region, evaluating impacts of PFJs programme on smallholders' household foods security. More research could be done to look at livelihoods of smallholder household heads in the region.
2. While this study focused on one of Ghana's sixteen (16) regions to determine the programme's contribution to food security, future studies could focus on any of the other the fifteen regions or even the entire country of Ghana.
3. The study found dramatic differences in the sex composition of sampled respondents in favor of males, meaning that the majority of the findings are unlikely to reflect the complete representation of women. Future research should include sex-specific comparative studies to determine a holistic impact of PFJs Programme on food security for male and female household heads in the region or elsewhere in Ghana.
4. Finally, a comparable study should be done to analyze impacts of the Corona Virus pandemic on a variety of factors, such as food security, crop specific yields, livelihoods, and overall welfare of farmers in Ghana's northern area and/or elsewhere.

REFERENCES

Abdulai, A., & Huffman, W. (2014). The adoption and impact of soil and water conservation technology: An endogenous switching regression application. *Land economics*, *90*(1), 26-43.

Abegaz, K. H. (2017). Determinants of food security: evidence from Ethiopian Rural Household Survey (ERHS) using pooled cross-sectional study. *Agriculture & Food Security*, *6*(1), 1-7.-1

Abubakari, M., Moomin, A., Nyarko, G., & Dawuda, M. M. (2017). Heavy metals concentrations and risk assessment of roselle and jute mallow cultivated with three compost types. *Annals of Agricultural Sciences*, *62*(2), 145-150.

Adzitey, F., Ekli, R., & Aduah, M. (2020). Incidence and antibiotic susceptibility of Staphylococcus aureus isolated from ready-to-eat meats in the environs of Bolgatanga Municipality of Ghana. *Cogent Environmental Science*, *6*(1), 1791463.

Augustine, T. Z., & Tekuni, N. (2020). Modernizing extension services to improve rice productivity: Lessons from Ghana €™ s planting for food and jobs program. *Journal of Agricultural Extension and Rural Development*, *14*(4), 110-115

Suvedi, M., Ghimire, R., & Kaplowitz, M. (2017). Farmers' participation in extension programs and technology adoption in rural Nepal: a logistic regression analysis. *The Journal of Agricultural Education and Extension*, *23*(4), 351-371.

Akudugu, M. A., Guo, E., & Dadzie, S. K. (2012). Adoption of modern agricultural production technologies by farm households in Ghana: what factors influence their decisions? *International Institute for Science, Technology and Education, Vol. 2; Issue 3.*

Akudugu, M.A.; Millar, K.K.; Mubarik, S. Crop Productivity and Implications for Food Security and Rural Livelihood Development in Africa. *Preprints.org 2020, 2020010327. v1.*

Abdulai, A. R. (2017). Analysis of the Policy Process: Food and Agricultural Sector Development Policy of Ghana in Perspective. *Environmental Policy Institute, Grenfell Campus-MUN*

Deetz, S., & Mumby, D. K. (1990). Power, discourse, and the workplace: Reclaiming the critical tradition. *Annals of the International Communication Association*, *13*(1), 18-47

Din, M. S. U., Mubeen, M., Hussain, S., Ahmad, A., Hussain, N., Ali, M. A., & Nasim, W. (2022). World nation's priorities on climate change and food security. *Building Climate Resilience in Agriculture: Theory, Practice and Future Perspective*, 365-384.

Ajaero, C. K. (2017). A gender perspective on the impact of flood on the food security of households in rural communities of Anambra state, Nigeria. *Food Security*, *9*(4), 685-695.

Akpan, S. B., & Udoh, E. J. (2016). Farmers' decision to participate in government agricultural programmes in a volatile political environment: a case study of

farmers in the South-South region of Nigeria. *Russian Journal of Agricultural and Socio-Economic Sciences*, *53*(5), 135-148.

Akudugu, M. A., Dittoh, S., & Mahama, E. S. (2012). The implications of climate change on food security and rural livelihoods: Experiences from Northern Ghana. *Journal of Environment and Earth Science*, *2*(3), 21-29.

Andani, A., Moro, A. H. B., & Issahaku, G. (2020). Fertilizer subsidy policy and smallholder farmers crop productivity: The case of maize production in North-Eastern Ghana. *Journal of Agricultural Extension and Rural Development*, *12*(2), 18-25.

Bayale, N., Ibrahim, M., & Atta-Mensah, J. (2022). Potential trade, welfare and revenue implications of the African Continental Free Trade Area (AfCFTA) for Ghana: An application of partial equilibrium model. *Journal of Public Affairs*, *22*(1), e2385.

Ali, E. B., Agyekum, E. B., & Adadi, P. (2021). Agriculture for sustainable development: A SWOT-AHP assessment of Ghana's planting for food and jobs initiative. *Sustainability*, *13*(2), 628.

Alvi, M. (2016). A manual for Selecting Sampling Techniques in Research, MPRA Paper No. 70218.

Anila, S., & Adiqa, K. (2011). Determinants of food security at household level in Pakistan. *African journal of business Management*, *5*(34), 12972-12979.

Aydoğan, M., Demiryürek, K., Özer, O. O., & Uysal, O. (2022). Factors accelerating agricultural innovation and sustainability: The case of paddy farmers. *Integrated Environmental Assessment and Management*, *18*(3), 824-835.

Ayerakwa, H. M., Dzanku, F. M., & Sarpong, D. B. (2020). The geography of agriculture participation and food security in a small and a medium-sized city in Ghana. *Agricultural and Food Economics*, *8*(1), 1-21.

Ayi, N. A. (2022). Farmer field school extension approach: A knowledge booster in Calabar Agricultural Zone, Cross River State, Nigeria. *Journal of Agricultural Extension and Rural Development*, *14*(2), 52-60.

Azumah, S. B. (2020). Assessing the Contribution of Planting for Food and Jobs (PFJ) Programme to Improved Seed Security in Ghana. No. 666/14

Azumah, S. B., & Zakaria, A. (2019). Fertilizer subsidy and rice productivity in Ghana: A microeconomic study. *Journal of Agricultural Studies*, *7*(1), 82-102.

Babu, S. C., & Blom, S. (2017). *Strengthening and harmonizing food policy systems to achieve food security*: A Case Study and Lessons from Ghana. *International Food Policy Resource Institute, (Vol. 1607*).

Banerjee, A., & Duflo, E. (2011). More than 1 billion people are hungry in the world. *Foreign Policy*, (186), 66-72.

Bashir, M. K., & Schilizzi, S. (2013). Determinants of rural household food security: a comparative analysis of African and Asian studies. *Journal of the Science of Food and Agriculture*, *93*(6), 1251-1258.

Bawa, A. (2019). Agriculture and Food Security in Northern Ghana. *Asian Journal of Agricultural Extension, Economics & Sociology 31(2): 1-7. Article no. AJAEES.35700 ISSN: 2320-7027.*

Benin, S., Johnson, M., Abokyi, E., Ahorbo, G., Jimah, K., Nasser, G., & Tenga, A. (2013). Revisiting agricultural input and farm support subsidies in Africa: The case of Ghana's mechanization, fertilizer, block farms, and marketing programs. *Fertilizer, Block Farms, and Marketing Programs (November 2013).*

Blizkovsky, P., Grega, L., & Verter, N. (2018). Towards a common agricultural policy in Africa?. *Agricultural Economics*, *64*(7), 301-315.

Boliko, M. C. (2019). FAO and the situation of food security and nutrition in the world. *Journal of nutritional science and vitaminology*, *65*(Supplement), S4-S8.

Adugna, E., & Wagayehu, B. (2012). Causes of household food insecurity in Wolayta: Southern Ethiopia. *Journal of Stored Products and Postharvest Research*, *3*(3), 30-43.

Beyene, F., & Muche, M. (2010). Determinants of food security among rural households of Central Ethiopia: an empirical analysis. *Quarterly Journal of International Agriculture*, *49*(892-2016-65219), 299-318.

Brüntrup, M. (2011). The Comprehensive Africa Agriculture Development Programme (CAADP)–An Assessment of a Pan-African Attempt to Revitalise Agriculture. *Quarterly Journal of International Agriculture*, *50*(892-2016-65189), 79-106.

Bulawayo, M., Ndulo, M., & Sichone, J. (2019). Socioeconomic determinants of food insecurity among Zambian households: Evidence from a national household survey. *Journal of Asian and African Studies*, *54*(6), 800-818.

Cafiero, C., Melgar-Quiñonez, H. R., Ballard, T. J., & Kepple, A. W. (2014). Validity and reliability of food security measures. *Annals of the New York Academy of Sciences*, *1331*(1), 230-248.

Carter, D. W., & Milon, J. W. (2005). Price knowledge in household demand for utility services. *Land Economics*, *81*(2), 265-283.

Christian, A. K., Marquis, G. S., Colecraft, E. K., Lartey, A., & Soueida, R. (2019). Household food insecurity but not dietary diversity is associated with children's mean micronutrient density adequacy in rural communities across Ghana. *Nutrition*, *65*, 97-102.

Codjoe, S. N. A., Okutu, D., & Abu, M. (2016). Urban household characteristics and dietary diversity: an analysis of food security in Accra, Ghana. *Food and Nutrition Bulletin*, *37*(2), 202-218.

Cordero-Ahiman, O. V., Vanegas, J. L., Beltrán-Romero, P., & Quinde-Lituma, M. E. (2020). Determinants of food insecurity in rural households: The case of

the Paute River basin of Azuay Province, Ecuador. *Sustainability*, *12*(3), 946.

Dagunga, G. (2020). Livelihood Diversification and Multidimensional Poverty in Ghana: Sustainable Livelihood Framework Approach (Doctoral Dissertation).

Dagunga, G., Amoakowaa, A., Ehiakpor, D. S., Mabe, F. N., & Danso-Abbeam, G. (2020). Interceding role of village saving groups on the welfare impact of agricultural technology adoption in the Upper East Region, Ghana. *Scientific African*, *8*, e00433.

Dagunga, G., Ayamga, M., & Danso-Abbeam, G. (2020). To what extent should farm households diversify? Implications on multidimensional poverty in Ghana. *World Development Perspectives*, *20*, 100264.

Darfour, B., & Rosentrater, K. A. (2016). Agriculture and food security in Ghana. In *2016 ASABE Annual International Meeting 162460507*(p. 1). *American Society of Agricultural and Biological Engineers*.

Di Falco, S., Yesuf, M., Kohlin, G., & Ringler, C. (2012). Estimating the impact of climate change on agriculture in low-income countries: Household level evidence from the Nile Basin, Ethiopia. *Environmental and Resource Economics*, *52*(4), 457-478.

Dittoh, S. (2013). Capacity Strengthening Strategy through Capacity Needs Assessment for Country Level Strategic Analysis and Knowledge Support System (SAKSS): Ghana.

Djangmah, G. M. (2016). Comparative analysis of food security status of farming households in eastern and northern regions of Ghana. *McGill University (Canada) ProQuest Dissertations Publishing, 2016. 28251212*.

Enu, P. (2014). Analysis of the agricultural sector of Ghana and its economic impact on economic growth. *Academic Research International*, *5*(4), 267-277.

Etikan, I., & Bala, K. (2017). Sampling and sampling methods. *Biometrics & Biostatistics International Journal*, *5*(6), 00149.

FAO, E. (2020). AUC.(2020). 2019 Africa regional overview of food security and nutrition. Containing the damage of economic slowdowns and downturns to food insecurity in Africa.

Ghana. Statistical Service. (2013). *2010 Population & Housing Census: Demographic, Social, Economic & Housing Characteristics*. Ghana Statistical Service.

Haddad, L., Hawkes, C., Webb, P., Thomas, S., Beddington, J., Waage, J., & Flynn, D. (2016). A new global research agenda for food. *Nature*, *540*(7631), 30-32.

Hill, A., & Kirwan, B. E. (2015). Factors affecting the Fertilizer-use decision of maize farmers in Ghana. *Journal of Sustainable Development*, *8*(9), 273.

Awiti, L. H. (2013). *Influence of Savings and Loans Associations in empowering women towards household food security in Bondo District, Kenya* (Doctoral dissertation, University of Nairobi).

Oluoko-Odingo, A. O. (2006). *Food security and poverty among small scale farmers in Nyando district, Kenya* (Doctoral dissertation).

Headey, D., & Ecker, O. (2013). Rethinking the measurement of food security: from first principles to best practice. *Food security*, *5*(3), 327-343.

Von Grebmer, K., Bernstein, J., Nabarro, D., Prasai, N., Amin, S., Yohannes, Y., & Thompson, J. (2016). *2016 Global hunger index: Getting to zero hunger. International Food Policy Resource Institute.*

Akukwe, T. I. (2020). Household food security and its determinants in agrarian communities of southeastern Nigeria. *Agro-Science*, *19*(1), 54-60.

Issahaku, G., & Abdulai, A. (2020). Can Farm Households Improve Food and Nutrition Security through Adoption of Climate-smart Practices? Empirical Evidence from Northern Ghana. *Applied Economic Perspectives and Policy*, *42*(3), 559-579.

Ingram, J. (2020). Nutrition security is more than food security. *Nature Food*, *1*(1), 2-2.

Ijeoma, E. (2012). Redeeming Financial Pledges for Africa's Implementation of the NEPAD Initiative: An Appraisal. *Africa's Public Service Delivery & Performance Review*, *1*(1), 38-54.

Iram, U., & Butt, M. S. (2004). Determinants of household food security: An empirical analysis for Pakistan. *International Journal of Social Economics*. Volume 31, Issue 8.

Ismaila, S., & Tanko, M. (2021). Exploring relative deprivation theory in the rice industry: Planting for Food and Jobs (PFJ) in northern Ghana. *Technology in Society*, *65*, 101556.

Gomda, A. Y. I. S. H. A. (2018). The participation of Persons with disabilities in Agriculture and its Effects on their food security situation in the Savelugu-Nanton Municipality (Doctoral dissertation).

Kan, I., Kimhi, A., & Lerman, Z. (2006). *Farm output, non-farm income, and commercialization in rural Georgia* (No. 888-2016-65015).

Perez-Escamilla, R., Gubert, M. B., Rogers, B., & Hromi-Fiedler, A. (2017). Food security measurement and governance: Assessment of the usefulness of diverse food insecurity indicators for policy makers. *Global Food Security*, *14*, 96-104.

Karakara, A. A., Osabuohien, E. S., Nwachukwu, J. C., & Osabohien, R. A. (2021). Innovations in savings behavior and agricultural business support for women: The Ghanaian 'Money-Box'. *African Journal of Reproductive Health*, *25*(5s), 147-158.

Kassie, M., Ndiritu, S. W., & Shiferaw, B. A. (2012). *Determinants of food security in Kenya, a gender perspective* (No. 354-2016-18147).

Kennedy, G., Berardo, A., Papavero, C., Horjus, P., Ballard, T., Dop, M. ... & Brouwer, I. D. (2010). Proxy measures of household food consumption for food security assessment and surveillance: comparison of the household

dietary diversity and food consumption scores. *Public Health Nutrition*, *13*(12).

Kleemann, J., Baysal, G., Bulley, H. N., & Fürst, C. (2017). Assessing driving forces of land use and land cover change by a mixed-method approach in north-eastern Ghana, West Africa. *Journal of Environmental Management*, *196*, 411-442.

Watsan, R. (2014). Quantitative Research Design.

Khonje, M., Manda, J., Alene, A. D., & Kassie, M. (2015). Analysis of adoption and impacts of improved maize varieties in eastern Zambia. *World Development*, *66*, 695-706.

Kuwornu, J. K., Mensah-Bonsu, A., & Ibrahim, H. (2011). Analysis of foodstuff price volatility in Ghana: Implications for food security. *European Journal of Business and Management*, *3*(4), 100-118.

Leroy, J. L., Ruel, M., Frongillo, E. A., Harris, J., & Ballard, T. J. (2015). Measuring the food access dimension of food security: a critical review and mapping of indicators. *Food and Nutrition Bulletin*, *36*(2), 167-195.

Leroy, J. L., Ruel, M., Habicht, J. P., & Frongillo, E. A. (2015). Using height-for-age differences (HAD) instead of height-for-age z-scores (HAZ) for the meaningful measurement of population-level catch-up in linear growth in children less than 5 years of age. *BMC Pediatrics*, *15*(1), 1-11.

Legendre, P., Fortin, M. J., & Borcard, D. (2015). Should the Mantel test be used in spatial analysis? *Methods in Ecology and Evolution*, *6*(11), 1239-1247.

Mabe, F. N., Danso-Abbeam, G., & Ehiakpor, D. S. (2018). Assessment of Implementation of Planting for Food and Jobs (PFJ Programmes: Lessons and Ways Forward.

Mabe, F. N. (2018). Farmer Innovations, Improved Agricultural Technologies and Productivity Heterogeneity of Rice Production in Ghana (Doctoral dissertation).

Maddala, G. S., & Nimalendran, M. (1995). An unobserved component panel data model to study the effect of earnings surprises on stock prices, trading volumes, and spreads. *Journal of Econometrics*, *68*(1), 229-242.

Maja, M. M., & Ayano, S. F. (2021). The impact of population growth on natural resources and farmers' capacity to adapt to climate change in low-income countries. *Earth Systems and Environment*, *5*(2), 271-283.

Martey, E., Etwire, P. M., Wiredu, A. N., & Dogbe, W. (2014). Factors influencing willingness to participate in multi-stakeholder platform by smallholder farmers in Northern Ghana: implication for research and development. *Agricultural and Food Economics*, *2*(1), 1-15.

Wiredu, A. N., Asante, B. O., Annin, K., Dogbe, W., Attoh, C., & Al-Hassan, R. M. (2013). Factors Influencing Participation in Rice Development Projects The Case of Smallholder Rice Farmers in Northern Ghana.

Maloka, E. (2006). NEPAD and its critics. *Africa and Development Challenges in the New Millenium. Pretoria: UNISA*, 86-104.

Mbow, C., Rosenzweig, C., Barioni, L. G., Benton, T. G., Herrero, M., Krishnapillai, M., & Xu, Y. (2019). Food security. *Potsdam-Institut fur Klimafolgenforschung*

MoFA, S. R. I. D. (2011). Agriculture in Ghana-Facts and figures (2010). *Ministry of Food and Agriculture (MoFA)-Statistics, Research and Information Directorate (SRID)*.

Mockshell, J. (2016). Two worlds in agricultural policy making in Africa? Case studies from Ghana, Kenya, Senegal and Uganda.

Kayode-Iyasere, E. A., Jegede, A. O., Owolabi, J. T., & Awe, F. C(2020). New Partnershp for Africa's Development (Nepad) and the Challenges for Africa's Development. *Journal of Critical Reviews, Vol 8, Issue 01, 2020. ISSN- 2394-5125*

Lambongang, M., Ansah, I. G. K., & Donkoh, S. A. (2019). Participation and Yield Effect of Ghana's Planting for Food and Jobs Programme in Bunkpurugu-Yunyoo District. *Ghana Journal of Agricultural Economics and Agribusiness, Vol. 2(1) 5-24.*

Mustapha, S., Alhassan, I., & Ustarz, Y. (2016). Evaluating the determinants of access to Ghana fertilizer subsidy program. *Asian Journal of Agricultural Extension, Economics & Sociology*, *11*(3), 1-11.

Mutea, E., Bottazzi, P., Jacobi, J., Kiteme, B., Speranza, C. I., & Rist, S. (2019). Livelihoods and food security among rural households in the northwestern Mount Kenya region. *Frontiers in Sustainable Food Systems*, *3*, 98.

Nahayo, A., Omondi, M. O., Zhang, X. H., LI, L. Q., PAN, G. X., & Joseph, S. (2017). Factors influencing farmers' participation in crop intensification program in Rwanda. *Journal of Integrative Agriculture*, *16*(6), 1406-1416.

Union, A. (2003). Comprehensive Africa agriculture development programme. *Midrand, South Africa: NEPAD*.

Ngulube, P., Mathipa, E. R., & Gumbo, M. T. (2015). Theoretical and Conceptual Frameworks in the Social and Management Sciences. Adressing research challenges: Making Headway in developing research.

Ntshangase, N. L., Muroyiwa, B., & Sibanda, M. (2018). Farmers' perceptions and factors influencing the adoption of no-till conservation agriculture by small-scale farmers in Zashuke, KwaZulu-Natal Province. *Sustainability*, *10*(2), 555.

Ngema, P. Z., Sibanda, M., & Musemwa, L. (2018). Household food security status and its determinants in Maphumulo local municipality, South Africa. *Sustainability*, *10*(9), 3307.

Nkomoki, W., Bavorová, M., & Banout, J. (2019). Factors associated with household food security in Zambia. *Sustainability*, *11*(9), 2715.

Nurideen, F. (2019). An assessment of the impact of the Planting for Food and Jobs Policy on smallholder farmers' food security in the Wa West district (Doctoral dissertation, University of Ghana).

Olabanji, E., Adebisi, F., Ese, U., & Emmanuel, O. (2017). Agricultural Output and Economic growth in Nigeria. *Journal of African Research in Business & Technology*, *516093*.

Osman, S. A. N. T. O. S. (2015). Assessing the Food Security Status of Smallholder Farm Households in the Northern Region of Ghana (Doctoral dissertation).

Headey Derek D. & Ecker Olivier. (2012). Improving the Measurement of Food Security. *International Food Policy Research Institute Discussion Paper No.01225.*

Oyetunde-Usman, Z., & Olagunju, K. O. (2019). Determinants of food security and technical efficiency among agricultural households in Nigeria. *Economies*, *7*(4), 103.

Owuso Essegbey, G., Nutsukpo, D. K., Karbo, N., & Zougmoré, R. B. (2015). National Climate-Smart Agriculture and Food Security Action Plan of Ghana (2016-2020). *CCAFS Working Paper*, No 139.

Pangaribowo, E. H., Gerber, N., & Torero, M. (2013). Food and Nutrition Security Indicators: A Review. *ZEF Working Paper No. 108*

Pernechele, V., Balié, J., & Ghins, L. (2018). *Agricultural policy incentives in sub-Saharan Africa in the last decade (2005–2016). Monitoring and Analysing*

Food and Agricultural Policies (MAFAP) synthesis study (No. 2143-2019-4790).

Perez-Escamilla, R., Gubert, M. B., Rogers, B., & Hromi-Fiedler, A. (2017). Food security measurement and governance: Assessment of the usefulness of diverse food insecurity indicators for policy makers. *Global Food Security*, *14*, 96-104.

Pinstrup-Andersen, P. (2009). Food security: definition and measurement. *Food Security*, *1*(1), 5-7.

Ministry of Food and Agriculture (MoFA). (2017). Planting for Food and Jobs: Strategic Plan for Implementation (2017–2020).

Maxwell, D., Caldwell, R., & Langworthy, M. (2008). Measuring food insecurity: Can an indicator based on localized coping behaviors be used to compare across contexts? *Food Policy*, *33*(6), 533-540.

Puhani, P. (2000). The Heckman correction for sample selection and its critique. *Journal of Economic Surveys*, *14*(1), 53-68.

Resnick, D., & Mather, D. (2016). Agricultural inputs policy under macroeconomic uncertainty: Applying the Kaleidoscope Model to Ghana's fertilizer subsidy programme *(2008–2015)* International Food Policy Resource Institution (Vol. 1551).

Ruel, M. T., Quisumbing, A. R., & Balagamwala, M. (2018). Nutrition-sensitive agriculture: what have we learned so far? *Global Food Security*, *17*, 128-153.

Ruel, M. T., Garrett, J. L., Hawkes, C., & Cohen, M. J. (2010). The food, fuel, and financial crises affect the urban and rural poor disproportionately: a review of the evidence. *The Journal of Nutrition*, *140*(1), 170S-176S.

Benin, S., Johnson, M., Abokyi, E., Ahorbo, G., Jimah, K., Nasser, G., & Tenga, A. (2013). Revisiting agricultural input and farm support subsidies in Africa: The case of Ghana's mechanization, fertilizer, block farms, and marketing programs. *F*ertilizer, Block Farms, and Marketing Programs (November 2013).

Scheiterle, L., Häring, V., Birner, R., & Bosch, C. (2019). Soil, Striga, or subsidies? Determinants of maize productivity in northern Ghana. *Agricultural Economics*, *50*(4), 479-494.

Tanko, M., Ismaila, S., & Sadiq, S. A. (2019). Planting for Food and Jobs (PFJ): A panacea for productivity and welfare of rice farmers in Northern Ghana. *Cogent Economics & Finance*, *7*(1), 1693121.

Tuholske, C., Andam, K., Blekking, J., Evans, T., & Caylor, K. (2020). Comparing measures of urban food security in Accra, Ghana. *Food Security*, *12*(2), 417-431.

Verneau, F., Amato, M., & La Barbera, F. (2021). Edible insects and global food security. *Insects*, *12*(5), 472.

Vondolia, G. K., Eggert, H., & Stage, J. (2021). The effect of fertilizer subsidies on investment in soil and water conservation and productivity among Ghanaian farmers using mechanized irrigation. *Sustainability*, *13*(15), 8242.

Yawson, D. O., Armah, F. A., Afrifa, E. K., & Dadzie, S. K. (2010). Ghana's fertilizer subsidy policy: early field lessons from farmers in the central region. *Journal of Sustainable Development in Africa*, *12*(3), 191-203.

Yousaf, H., Zafar, M. I., Anjum, F., & Adil, S. A. (2018). Food security status and its determinants: a case of farmer and non-farmer rural households of the Punjab, Pakistan. *Pakistan Journal of Agricultural Sciences*, *55*(1).

Yusuf, S. A., Balogun, O. L., & Falegbe, O. E. (2015). Effect of urban household farming on food security status in Ibadan metropolis, Oyo State, Nigeria. *Journal of Agricultural Sciences (Belgrade)*, *60*(1), 61-75.

Zimmermann, R., Brüntrup, M., Kolavalli, S., & Flaherty, K. (2009). Agricultural policies in Sub-Saharan Africa: understanding CAADP and APRM policy processes (No. 48). Studies.

Zhou, D., Shah, T., Ali, S., Ahmad, W., Din, I. U., & Ilyas, A. (2019). Factors affecting household food security in rural northern hinterland of Pakistan. *Journal of the Saudi Society of Agricultural Sciences*, *18*(2), 201-210.

Appendix 1: Research Questionnaire

UNIVERSITY FOR DEVELOPMENT STUDIES

NYANKPALA CAMPUS

EVALUATING THE CONTRIBUTION OF PLANTING FOR FOODS AND JOBS ON FOOD SECURITY IN NORTHERN REGION OF GHANA.

I am SEIDU AMINU, student from UDS, Nyankpala Campus collecting data for purely academic purposes. The research aims at **CONTRIBUTION OF PFJs ON FOOD SECURITY IN NORTHERN REGION OF GHANA**. In the proceedings of the interview, you have the freedom to intrude me for any clarification. You also have the legal right to phone in my research supervisor (Dr. Gifty Sienso) on 0242574273 and ask for any clarification at any point in time. I respect all your responses and appreciate your collaboration. ***I assure you that your responses would be anonymous and confidential***

1.0 Demographics.

1.1 Name of respondent	
1.2 Contact number of respondents	
1.3 Name of community	
1.4 Are you the head of this household?	(1. Yes [ ] (2) No [ ]

1.5 If no, what is your relationship with this household head?	1) Spouse [ ] (3) Child/House help [ ] 2) Parent/Parent-in-law [ ] (4) Brother/sister [ ] (5) Any other, specify…..
1.6 Age of respondent	……. ***(Please verify with his/her birth cert/ID/NHIS)***
1**.7 Sex** of respondent	Male [ ] (2) Female [ ]
1.8 Marital status of respondent	(1) Married [ ] (2) Single [ ] (3) Divorced/separated [ ] (4) Widowed [ ]
1.9 Household (HH) size	…….
1.10 How many of the above (1.9) falls within these age categories?	(1) 0-10yrs … (2) Above 65yrs ……
1.11 Respondent number of years in crop farming	Answer …….
1.12 Can you read, construct or write a simple sentence?	(1) Yes [ ] (2) No [ ]
13 Please tick the highest level of education attained by the respondent	(1 (1) Non-formal/Islamic education [ ] (4) Voc/Tech/SHS [ ] 2) Primary school [ ] (5) Tertiary [ ] (3) Middle school/JHS [ ]

1.14 Number of years of schooling by respondent	
1.15 Please which political party do you ng to? *indicate the political party affiliation*	N.P.P [ ] (2) N.D.C [ ] (3) PNC [ ] C. P.P [ ] (5) PPP [ ] (6) NDP [ ]

2.0 Farm / Non-farm income characteristics

Farm plot

A B C D E F

2.1 Crop

2.2 Size (acres)

2.3 Quantity harvested

Non-farm income sources

A B C D E Totals

2.4 Economic activity

2.5 Amount earns per nth in this farming season

2 2.6 Do you own a nland in this community? 1. Yes [ ] 2. No [ ]

2.7 If yes, how did you acquire the land? (1) Bought (2) inherited (3) Gift (4) Others specify

2.8 What type of livestock do you keep? 1. Cattle [ ] 2. Goats [ ] 3. Sheep [ ] 4. Donkeys [ ] 5. Others, specify……

3. Planting for food and Jobs

3.1 Have you participated in Planting for Food and Jobs? .) Yes [ ] (2) No [ ]

3.2 If yes, what have you received from the program?) Fertilizer [ ] (2) Improved Seeds [ ] (3) Extension services [ ] (4) Marketing [ ] (5) E-agriculture [ ]

3.3 Do you receive subsidized fertilizer from MoFA? 1) Yes [ ] (2) No [ ]

3.4 If yes, how many bags?

3.5 Do you receive subsidized Improved seeds from MoFA? 1) Yes [ ] (2) No [ ]

3.6 If yes, quantity? (In kilograms)

.7 Do you receive extension visit from MoFA?

3.8 If yes, how many times?

3.9 Do you receive market information from MoFA? l) Yes [ ] (2) No [ ]

3.10 If yes, how many times?

. 3.11 Do you face any form of government bureaucracy in accessing any of the above-tioned in intervention in PFJs? l) Yes [ ] (2) No [ ]

3 3.12 If yes, how and what are the process involve if any?

3.13 What is the distance from your house to MoFA office in kilometers?

4. Agricultural knowledge gained and institutional factors

4.1 Are you a member of any farmer-ıised organization in this community? (1) Yes [ ] (2) No [ ]

4.2 If yes, what kind of support do ıu get from this/these organization (s)? Multiple response

1. Financial support [ ]
2. Inputs supply [ ]
3. Technical support [ ]

4.3 Do you belong to a VSLA?

4.4 Have you attended any Farmer Field School or demonstration farm in the past 2 years? (1) Yes [ ] (2) No [ ]

4.5 If, yes, number of times

4.6 Do you have agriculture related NGO's operating in your community?	(1) Yes [ ]	(2) No [ ]
4. 7 Have you received credit for ming for the past 2 years for farming?	(1) Yes [ ]	(2) No [ ]
4.8 If yes, how much were you given?	GHS…..	
4.9 Do you receive weather information?	(1) Yes [ ]	(2) No [ ]
4.9 If yes, how many times have you receive weather update in the past 12 month?		
4.10 Do you receive market information?	(1) Yes [ ]	(2) No [ ]
4.11 If yes, how many times have you received market information in the past 12 months?		

5: Incomes

Kindly indicate the annual income of the following household members from the sources below.

5.1 What is your main (1) Crop farming [ ] 2. Livestock farming [ ] 3. Hunting [ ] 4. Trading and commerce [ ]

source of income? 5. Civil Servant [ ] 6. Others specify……

Off farm (GHS)	Farm (GHS)	Remittances (GHS)

6 Household Food security Score.

Food group	Examples	Did your household consumed … in the past 7 days?	If yes, how many times in the past 7 days has your household consumed …
		1 (Yes) 0 (No)	
Cereals	maize, millet etc		
Vegetables	okra, Tomatoes etc		
Tubers	yam, Cassava etc		
Fruits	mango, Orange etc		
Meat and fish	chicken, beef etc		
Dairy products	Cow milk etc		
Eggs			
Pulse			
Oils and fats			
Sugar and sweets			

Spices, condiments,

beverages

7.0 Constrains to participating in PFJ

Please rank the following constrains in a most pressing order.

N	Constraints	Rank
1	Long distance to registration and distribution points	
2	Late distribution of seeds and fertilizer	
3	Poor quality of seeds	
4	Poor quality of fertilizer	
5	Political interference	
6	Cumbersome registration process	
7	Unavailability of fertilizer	
8	Market challenges	
9	Inadequate extension services	
10	Inadequate harvesting equipment to facilitate bumper yields	

Thank you for your time!

Appendix 2: Test for Multicollinearity.

A. Determinants of PFJ Participation using OLS.

Variable	Coefficient	(Robust Std. Error)
Age	0.007***	(0.002)
Sex	0. 006	(0. 067)
Household size	-0.006*	(0.004)
Education (Years)	0.014***	(0.005)
Marital status	-0.037	(0. 063)
Farm Experience	-0.010***	(0.002)
Dependency ratio	0.176	(0.136)
VSLA	0. 0644	(0. 049)
Farm size	0.006	(0.004)
Land Ownership	0.148**	(0.067)
FBO Membership	0.074*	(0.045)
Production Credit (Dummy)	0.076*	(0.047)
Farm income	0.036	(0.026)
Nonfarm Income	0.030***	(0.007)
Farmer Field School	0.335***	(0.055)
Political affiliation	0.162***	(0.032)

Distance to MoFA	-0.002	(0.003)
Constant	-0.338	(0.206)
Num of Obs = 400	**Prob>F =0.00**	**Adj R-square= 0.351**
F(17, 382) = 13.71	**R-Square=0.379**	**Root MSE= 0.403**

B. Command: estat vif

Variable	**VIF**	**1/VIF**
Age	1.80	0.555
Sex	1.37	0.732
Household size	1.12	0.896
Education (Years)	1.19	0.837
Marital status	1.25	0.803
Farm Experience	1.76	0.568
Dependency ratio	1.11	0.901
VSLA	1.12	0.891
Farm size	1.46	0.683
Land Ownership	1.16	0864
FBO Membership	1.25	0.798
Production Credit (Dummy)	1.13	0.886
Farm income	1.52	0.657

Nonfarm Income	1.21	0.823
Farmer Field School	1.15	0.868
Political affiliation	1.12	0.895
Distance to MoFA	1.16	0.862
Mean VIF	**1.29**	

Appendix 3: Test for Heteroscedasticity.

A. Determinants of PFJ Participation using OLS.

Variable	**Coefficient**	**(Robust Std. Error)**
Age	0.007***	(0.002)
Sex	0. 006	(0. 067)
Household size	-0.006*	(0.004)
Education (Years)	0.014***	(0.005)
Marital status	-0.037	(0. 063)
Farm Experience	-0.010***	(0.002)
Dependency ratio	0.176	(0.136)
VSLA	0. 0644	(0. 049)
Farm size	0.006	(0.004)
Land Ownership	0.148**	(0.067)
FBO Membership	0.074*	(0.045)

Production Credit (Dummy)	0.076*	(0.047)
Farm income	0.036	(0.026)
Nonfarm Income	0.030***	(0.007)
Farmer Field School	0.335***	(0.055)
Political affiliation	0.162***	(0.032)
Distance to MoFA	-0.002	(0.003)
Constant	-0.338	(0.206)
Num of Obs = 400	**Prob>F =0.00**	**Adj R-square= 0.351**
F(17, 382) = 13.71	**R-Square=0.379**	**Root MSE= 0.403**

B: Command: estat hottest.

Breusch-pagan/ Cook-Weisberg test for heteroscedasticity.

Ho: Constant variance

Variables: fitted values of PFJ

Chi2 (1) =0.01

Prob> chi2 =0.9051