THE INFLUENCE OF CAPACITY BUILDING PROJECTS ON FARMER INNOVATIVE PERFORMANCE AND POVERTY REDUCTION: THE CASE OF USAID FEED THE FUTURE PROJECTS IN NORTHERN GHANA

BY

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DECLARATION

I do hereby declare that this thesis is my own work and has not been previously submitted for a degree at this or any other academic institution. All references consulted in the work have been duly acknowledged. I am solely responsible for any shortcomings that may be identified in the work.

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ABSTRACT

Capacity building constitutes an integral part of development assistance that seeks to build the understanding, skills, and knowledge base of individuals and institutions in developing countries in a bid to improve the productivity of agriculture. Out of about 41.2% of the economically active people who are engaged in agriculture in Ghana, 72% are in northern Ghana. The study set out to investigate how farmer participation in the USAID Feed the Future Initiative capacity- building activities influenced their innovative performance and how that affected their yields in northern Ghana. The study also examined the relationship between the yields of the selected crops and the incomes, food security, and well-being of the farmers in that part of the country. The study was conducted in eight districts in all the five northern regions in Ghana. The study adopted a mixed-method approach and therefore used both qualitative and quantitative data. Using a survey and focus group discussions, data was collected from 314 farmers who participated in the selected capacity-building projects of the USAID FtF initiative in Ghana. The data was analysed with descriptive statistics, Wilcoxon sign ranked test, Ordinary Least Squares (OLS) regression, Chi-square test and Kruskal-Wallis test. The study revealed that farmer participation in the USAID FTF capacity-building projects influenced their innovative performance in terms of the utilization and sharing of the knowledge and skills acquired from the project activities. The majority of the farmers acquired high knowledge, and a majority are also practicing what they have learnt. The Principal Component Analysis (PCA) revealed that utilization of knowledge and information sharing impacted innovative performance as compared to knowledge acquisition alone. However not many of the farmers are sharing information about the things they have learned. This affected their innovative performance. As a result,

farmer innovative performance did not influence the yield of the selected crops as was expected. However, the yields of the crops improved after farmers participated in the project activities. It was also revealed that there is a significant relationship between farmers' crop productivity and their incomes which was expected to impact their food security and well-being. Although there was a significant relationship between maize productivity and food security, there was no significant relationship between rice and soybean productivity and food security. There was statistically significant relationship between rice and soybean productivity and farmers' well-being but no statistically significant relationship between maize productivity and well-being. Generally, there is perceived improvement in income, food security and well-being of the farmers after participating in the project activities. This implies that the capacity building projects have impacted poverty positively and have enhanced poverty mitigation in northern Ghana. The study recommends that government policies and programmes meant to improve farmer innovativeness should target building the capacity of farmers through field demonstrations. Government policies should also support innovative farmers to lead farmer to farmer extension. It is also recommended that effort must be put into the continuous improvement of maize productivity to boost farmers' incomes and enhance their well-being in northern Ghana.

DEDICATION

This work is dedicated to my late mum, Madam Mary Dede Ahemlem Odonkor.

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LIST OF ABBREVIATIONS

AAGDS	Accelerated Agriculture Growth and Development Strategy
ACDEP	Association of Church-Based Development NGOs
ACDI/VOCA	Agricultural Cooperative Development International/Volunteers in Overseas Cooperative Assistance
ACET	African Center for Economic Transformation
ADB	Agricultural Development Bank
ADP	Agricultural Diversification Project
ADVANCE	Agricultural Development and Value Chain Enhancement
AEOs	Agricultural Extension Agents,
AgNRM	Agriculture and Natural Resource Management Project
APSP	Agricultural Policy Support Project
ASAC	Agricultural Sector Adjustment Credit
ASIP	Agricultural Sector Investment Project
ASTF	Africa Solidarity Trust Fund
ATT	Agricultural Technology Transfer
BHEARD	Borlaug Higher Education for Agricultural Research and Development
BUSAC	Business Sector Advocacy Challenge
CAADP	Comprehensive Africa Agriculture Development Programme
CAPI	Computer Assisted Personal Interviewing
CACS	College of Agriculture and Consumer Sciences
CDCS	Country Development Cooperative Strategy
CERSGIS	Centre for Remote Sensing and Geographic Information Services
COVID	Corona Virus and Disease
CREMA	Community Resource Management Area
CSIR	Council for Scientific and Industrial Research
CSLP	Coastal Sustainable Landscape Project
DAES	Directorate of Agricultural Extension Services
DANIDA	Danish International Development Agency
DFAS	Department of Fisheries and Aquatic Sciences'
DOC	Department of Cooperatives
EC	European Commission
ECOWAS	Economic Community of West African States
ECOWAP	ECOWAS Agricultural Policy
FAO	Food and Agriculture Organisation
FASDEP	Food and Agricultural Development Policy
FBOs	Farmer-Based Organisations
FCBP	Fisheries Capacity Building Project
FFS	Farmer Field School
FIES	Food Insecurity Experience Scale
FLS	Front-line staff
FRMP	Forestry Resource Management Project
FSP	Fertilizer Subsidy Programme
FtF	Feed the Future

GAP	Good Agronomic Practices
GASIP	Ghana Agricultural Sector Investment Programme the
GCAP	Ghana Commercial Agricultural Project
GDP	Gross Domestic Product
GEF-SGP	Global Environment Facility Small Grants Programme
GIZ	Deutsche Gesellschaft für Internationale Zusammenarbeit
GLSS	Ghana Living Standard Survey
GoG	Government of Ghana
GSS	Ghana Statistical Service
HIV/AIDS	Human Immunodeficiency Virus, Acquired Immunodeficiency Syndrome
HLF4	Fourth High Level Forum on Aid Effectiveness/
ICT	Information and Communications Technology
IFAD	International Fund for Agricultural Development
IFDC	International Fertilizer Development Centre
IFJ	Investing for Food and Jobs
IP	Innovative Performance
KBV	Knowledge Based View
KIS	Kpong Irrigation Scheme
KLBIP	Kpong Left Bank Irrigation Project
LM	Logic Model
MAG	Modernization of Agriculture in Ghana
MDG	Millennium Development Goals
METASIP	Medium-Term Agriculture Sector Investment Plan
METSS	Monitoring, Evaluation and Technical Support Services
MFEP	Ministry of Finance and Economic Planning
MMDAs	Metropolitan Municipal and District Assemblies
MoFA	Ministry of Food and Agriculture
MSMEs	Small and medium-sized enterprises
MTADP	Medium-Term Agricultural Development Programme
MTNDPF	Medium-Term National Development Policy Framework
NAIP	The National Agriculture Investment Plan
NARP	National Agricultural Research Project
NDPC	National Development Planning Commission
NPCC	National Project Coordination Center
NEF	New Economics Foundation
NGOs	Non-Governmental Organisations
NLSP	National Livestock Services Project
NORRIP	Northern Region Rural Integrated Project
NRGP	Northern Rural Growth Programme
ODK	Open Data Kit
OECD	Economic Cooperation and Development
OFY	Operation Feed Yourself
OFYI	Operation Feed Your Industries
OLS	Ordinary Least Squares
OPDP	Oil Palm Development Project

PCA	Principal Component Analysis
PFJ	Planting for Food and Jobs
PHC	Population and Housing Censors
PICA	Power Innovation in Commercial Agriculture
RAFiP	Rural and Agricultural Finance Programme
R&D	Research and Development
RBV	Resource Base View
RELCs	Research and Extension Liaison Committees
REP	Rural Enterprises Programme
RFP	Rural Finance Project
RING	Resiliency in Northern Ghana
RTIMP	Root and Tuber Improvement Programme
SADA	Savannah Accelerated Development Authority
SARI	Savana Agricultural Research Institute
SCD	Supply Chain Development
SDGs	Sustainable Development Goals
SFMP	Ghana Sustainable Fisheries Management Project
SGDA	Shared Growth and Development Agenda
SIL	Soybean Innovation Lab
SL	Social Learning
SLM	Sustainable management of land and environment
SME	Small and medium enterprises
SNV	Netherlands Development Organization
SRID	Statistics Research and Information Directorate
SSA	Sub-Saharan Africa
SSIDP	Small-Scale Irrigation Development Project
SWLS	Satisfaction with Life Scale
TFP	Total Factor Productivity
TIP	Trade and Investment Program
TIPCEE	Trade and Investment Program for a Competitive Export Economy
TIRP	Trade and Investment Reform Program
UAES	Unified Agricultural Extension Service
UCC	University of Cape Coast
UG	University of Ghana
UN	United Nations
UNDP	United Nations Development Program
UNICEF	United Nations Children's Emergency Fund
UNSDP	UN Sustainable Development Partnership
URADEP	Upper Regional Agricultural Development Project
USA	United States of America
USAID	United States Agency for International Development
USAID/UG FtF	USAID/UG Institutional Capacity Building for Agriculture Productivity
USDA	United States Department of Agriculture
VSLA	Village Savings and Loan Association

WFP	World Food Programme
WHO	World Health Organisation

CHAPTER ONE

INTRODUCTION

1.1 Background

In this rapidly changing global environment it has become pertinent for the capacities of agricultural producers to be developed to keep abreast with the times. Capacity building has emerged as "an integral part of development assistance and seeks to build the understanding, skills, and knowledge base of individuals and institutions in developing countries" (Gordon & Chadwick, 2007: 15). Capacity building has therefore been a major focus for the development of agriculture in developing countries. This is based on the conviction that building the capacity of individuals for knowledge enhancement is critical in the improvement of agricultural productivity through adoption of new and improved technologies (FAO, 2017c).

Farmers' capacity building to improve their knowledge and skills to improve productivity and reduce poverty in Northern Ghana is core to the goal of the Feed the Future (FtF) Projects selected for this study. The projects are agricultural interventions, which sought to build capacities of stakeholders (farmers and researchers) in terms of human capital development, financial, social among others. These capacities intend to improve their innovative performance which can lead to increased yields and ultimately poverty reduction.

According to Nakano et al. (2018) agricultural capacity building is the potential to effectively deal with poverty alleviation in rural communities. In their study, Nakano et al. (2018) observed that technology adoption rate, productivity, and profitability of trained farmers rose immediately after a capacity building which resulted in a wide paddy rice yield difference (3.1 tons per hectare to 5.3 tons per hectare) compared to untrained farmers (2.6 tons per hectare to 3.7 tons per hectare). Takahashi (2017) further indicated that agricultural training is an effective way of disseminating relevant new technologies to increase productivity. In an impact assessment of capacity building and training, Gordon and Chadwick (2007) indicated that human capital development and improved productivity are benefits of capacity building. When an individual's capacity is improved it adds to their well-being (Gordon & Chadwick, 2007). This implies that, participation in training enhances the social well-being of individuals such as health, child quality, lowers fertility rates, more efficient consumer choices, and lower crime rates.

Through capacity building smallholder farmers acquire the requisite knowledge and skills which when utilized enable them to improve their productivity (Chindime et al., 2017). At the same time, smallholder farmers are expected to innovate with the knowledge they have acquired to improve their yields, incomes, food security, and well-being. Farmers' utilization of knowledge acquired through capacity building and information sharing constitute innovative performance which is expected to improve yields of the farmers. Several studies (Chindime et al., 2017; Adebayo et al., 2017; Meynard, 2016) reveal that capacity building leads to innovative performance which results in improvement in productivity. Higher productivity enables farmers not only to have enough food to feed their households, but also to acquire income from the sale of the surpluses to meet their non-food needs (ACET, 2017) leading to poverty reduction.

Poverty is a global phenomenon but most prominent in Sub Saharan Africa (SSA). Globally about 75% of the poor live in rural areas and depend on agriculture (Bello, 2021). In Ghana for example, about 60% of the population live in rural areas and depend directly or indirectly on agriculture for livelihood and survival (Armah et al., 2011; MoFA, 2013). The pervasiveness of poverty in different continents of the world are major concerns for scientists and researchers. However, with the new implemented sustainable development goals (SDGs), countries have committed to end poverty by the year 2030 (Bello, 2021). This is to be achieved through targeting agriculture (Mozumdar, 2012).

Due to the agrarian nature of developing countries' economies including Ghana, most poverty reduction interventions in these countries have focused on agriculture (Hounkonnou, et al., 2012; Dolinska & d'Aquino, 2016). This is because of its role in addressing poverty in the developing world, in providing livelihoods for most rural dwellers who depend indirectly and directly on it for subsistence (Dolinska & d'Aquino, 2016; Bello, 2021).

Agricultural growth through increase in agricultural productivity result in a significant poverty reduction impact in comparison to increase in other sectors (FAO, 2017a; Ivanic & Martin, 2018). According to Bello (2021), income and price are the most important channels through which poverty reduction could be achieved through agriculture. Bello further indicates that growth in agricultural income is important in stimulating the growth of overall economy and can intensify the well-being of the poor in the effort to end poverty. In this study poverty reduction implies improved incomes, food security and well-being of smallholder farmers.

Owing to the importance of agriculture to the economy of Ghana and its role in poverty reduction, governments and development partners over the years have initiated and implemented countless projects and programmes to address poverty and food insecurity in Ghana especially northern Ghana. However, the northern part of Ghana has remained the poorest regions in the country for decades. According to the Ghana Statistical Service (GSS) (2012), there are about 41.2% of the economically active people engaged in agriculture countrywide and out of this percentage 72% are in northern Ghana. There is persistent poverty in that part of the country and therefore the people continue to receive attention in addressing the poverty gap between the north and the south of Ghana.

In Sub-Saharan Africa agriculture is characterized by low productivity, meanwhile agriculture is the major driver of the economies in SSA because it stimulates sustainable rural development and enhances the living conditions of the rural poor (Corral et al., 2017). Ghana is no exception to low agricultural productivity which affects SSA. In most parts of Northern Ghana for example, low agricultural productivity has resulted in widespread poverty (Muzari, 2016) because of low incomes derived from low crop yields (Wood, 2013). This situation has earned the three Northern Regions an unenviable status of being the poorest regions in Ghana which together contribute over 67.2 % of people living in extreme poverty in Ghana, Ghana Living Standard Survey (GLSS 7; 2018).

In Ghana, several factors contribute to low agricultural production leading to poverty of the rural folks. Some of these factors include, the land holding systems, lack of funds, absence of adequate credit facilities from the banks, aging farmers, inadequate pest control measures and post-harvest losses. According to Boahen et al. (2020) Ghana's agricultural sector which is dominated mainly by smallholder farmers is faced with low productivity which is due to low technology adoption and declining soil fertility, weak infrastructure, low market access, and high transaction cost.

In an assessment of the effect of crop productivity on poverty among farm households in Ghana Boahen et al. (2020) noted that crop farmers' poverty rate is higher in northern Ghana compared to the South. This situation has been attributed to long periods of continuous cropping of the same land without soil restoration as well as adverse weather conditions in that part of the country. The result is low incomes, food insecurity. and poor welfare of the farmers leading to persistent poverty. Also, the farmers find it difficult to acquire and use improved technologies which is of a huge concern. A baseline study of the Agricultural Technology Transfer (ATT) project undertaken in 2014 revealed that yields of maize, rice, and soybean in northern Ghana lagged far behind national averages. This was attributed to famers low use of improved certified seed (IFDC, 2018). Addressing these challenges within the agricultural sector to improve productivity is strategic in the effort to alleviate poverty (Nakano et al., 2018).

There is consensus in development theory and agricultural extension practice that stakeholders who are concerned with or affected by a problem, in this case, low agricultural productivity in northern Ghana, can jointly learn their way out of this problem (Nederlof

& Pyburn, 2012). Therefore, the need for capacity-building interventions that will encourage joint learning to enhance smallholder farmer innovativeness in improving productivity cannot be over-emphasized.

Participation in capacity building projects/activities is expected to lead to improved productivity, incomes, and reduction in poverty. It is therefore important that effective farmer participation is ensured, and their interests sustained in capacity building projects. This could be achieved by for example building their capacities in good agronomic practices, facilitating their access to improved seeds and other yield enhancing inputs, finance, and access to markets (Etwire et al., 2013; Acheampong et al., 2018).

Over the years, several interventions have been implemented in Ghana to mitigate the adverse effect of challenges facing smallholder farmers in agricultural practice. A review of agricultural projects implemented in Ghana under the Medium-Term Agricultural Development Programme (MTADP) by Gyenfie et al. (2014) revealed some projects that did not achieve their objectives. These projects were set to achieve a common goal of accelerating agricultural growth as well as improving smallholder farmers' income. This was to be achieved through productivity improvement and diversification. These projects include the National Agricultural Research Project (NARP) implemented from 1992 to 1997, Root and Tuber Improvement Programme (RTIMP), the Small-Scale Irrigation Development Project (SSIDP) implemented between 1999 and 2009, Upper Regional Agricultural Development Project (URADEP) which later transformed into Northern Region Rural Integrated Project (NORRIP) because of poor approach (top-down) used under the former (Chambers, 1980, cited in Yaro, 2013).

Under NARP the relatively high cost of the technologies did not make the project beneficial to poor farmers. In the case of RTIMP, the goal of reducing poverty was not achieved due to deficiencies in the design of the project. There were also difficulties in the implementation of planned activities and postproduction and marketing issues were also neglected. In the case of SSIDP, because of the failure of the Government in fulfilling local conditions, incompetence or non-performance of the contractors and lack of supervision (Government of Ghana, 2013), the farmers did not adopt the technologies. This was because of institutional wrangling between MOFA and URADEP which compromised the operations of the organisation. Ambitious project objectives coupled with inadequate funding led to poor execution of project activities. According to Yaro (2013), poor sequencing of activities defeated the whole concept of holistic development of integrated rural development.

The failure of these projects has been attributed to the top-down approaches, which does not encourage farmer effective participation in project activities (Wood, 2013). However, there were some project benefits such as infrastructure development in the form of health, education, irrigation, roads, and office buildings. In the area of capacity building, the technical experiences gained by the farmers from the application of technologies are worth mentioning. In addition, government and international donors learned a great deal in project planning and implementation (Yaro, 2013). These are a few examples of interventions that did not make the needed impact on the smallholder farmer, hence the need to find or develop new approaches that will make the necessary impact. The failure of these projects to address smallholder farmers' challenges mentioned earlier in northern

Ghana is evident in the low incomes, food insecurity, and poor well-being resulting in persistent poverty in northern Ghana.

Against this backdrop the United States of America Government initiated the Feed the Future (FtF) Ghana initiative in 2011, which aims at improving economic opportunities and diversify household income in rural northern Ghana by working with the Government of Ghana and other partners such as research institutions, Universities, Non-Governmental Organisations (NGOs) and other stakeholders (USAID, 2016). In this regard several capacity-building projects under the USAID FtF initiative have been undertaken in northern Ghana, some of which are completed and others on-going as at the time of conducting this study.

The overall goal of FtF in Ghana is to reduce the prevalence of poverty and stunting in northern Ghana by 20%. In this regard, several projects including capacity building projects have either been implemented or are being implemented in northern Ghana to strengthen the maize, rice, and soybean value chains, introduce improved and climate-smart production methods; and to build the capacity of smallholder farmers, and other key stakeholders (USAID, 2016).

1.2 The selected USAID Feed the Future Capacity Building Projects under study

Through a consultative process with USAID Ghana, four capacity-building projects were selected for this study. The four selected projects are part of a myriad of projects being funded by USAID under the FtF initiative in Ghana. The rest of the FtF projects have been presented in appendix 4 of this study. The ensuing section introduces the selected projects for this study.

1.2.1 Agricultural Development and Value Chain Enhancement (ADVANCE) Project

The ADVANCE project is the main value chain project of the USAID Ghana Mission's FtF program. The project is a five-year project implemented by a consortium led by ACDI/VOCA that started in February 2014. The project's goal was to increase the competitiveness of maize, rice, and soybean value chains in Ghana. The project supported smallholder farmers to improve agricultural production and linked them to out-grower businesses that provided them with inputs, improved farming technologies and services. Under the project demonstration sites were established for training smallholders in good agronomic practices (GAP). The trainings were conducted in collaboration with the Ministry of Food and Agriculture (MOFA) (Agricultural Development and Value Chain Enhancement (USAID ADVANCE Project II, 2018).

Under the capacity building the farmers were introduced to Good Agricultural Practices (GAP) which involved land preparation, use of certified seed, fertilizer application, compost preparation, application of compost and top dressing with inorganic fertilizer, planting in rows, weeding at the recommended times, and FBO dynamics. They were also taught appropriate grain storage mechanisms. Other services provided include the provision of tractor and sheller services.

1.2.2 Agricultural Technology Transfer (ATT)

The ATT project was implemented by a team led by International Fertilizer Development Centre (IFDC) from April 2013 to 2018. The overall goal of ATT was to increase the competitiveness of the value chains of the selected crops to foster broad and sustained economic growth and agricultural productivity among small farmer households and agribusiness entrepreneurs in the region. The project was expected to increase yields of maize, rice and soya by at least 100%, 55%, and 40% respectively by introducing newly released seed varieties and new soil fertility technologies or appropriate management practices (IFDC, 2018).

The farmers were trained in seed production under the following guidelines: isolating the fields, timely harvesting, no intercropping, field hygiene, destroying off type seeds/plant, removing unwanted materials from the field and fertilizer application in seed. The farmers were also trained in GAPs and were also introduced to the use of cubed fertilizers for the cultivation of the selected crops. The GAPs activities included land preparation, planting in rows and the seed rates, fertilizer recommendation and application, weeds, pests and diseases control, harvesting at the right time, transportation and handling, drying, packaging and storage. They were given matching grants and were provided with shellers.

1.2.3 Sahel Grains - Increase Productivity and Incomes of Farmers in the Savannah Accelerated Development Authority (SADA) Region

Sahel Grains Project was implemented by Sahel Grains Company Limited. The overall goal of the project was to contribute towards improving food security and higher income in the SADA areas through targeted investments along the maize value chain. The specific objectives were

- Provision of farm-level support and aggregation services to smallholder farmers.

- Development of bulk handling of maize to enhance efficiency, comprehensiveness and gender inclusion in the quantity, quality, and standards of maize markets.

- Improvement in the quantity, quality and standards of maize marketed.

- Provision of access to a broader range of market opportunities (Boateng, 2015).

Farmers were introduced to GAPs which included use of improved seed varieties, site selection site, water and soil requirement, land preparation (ploughing across slopes), planting in rows and the seed rates, fertilizer recommendation, weeds, pests and diseases control, timely harvesting, transportation, and handling, drying, packaging and storage. They were also provided with post-harvest handling and mechanisation support.

1.2.4 USAID/UG Institutional Capacity Building for Agriculture Productivity (USAID/UG Feed the Future) Project

The USAID/UG Feed the Future Project is a collaboration between USAID Ghana and the University of Ghana. The project was awarded to the University of Ghana in February 2015 and scheduled to end in February 2020 but was granted a no-cost extension to March 2021. The overall goal of the project is to "improve sustainable agricultural productivity and food security through the training of scientists in plant breeding, biotechnology, crop and soil science, economic policy management, and business capacity building in response to the need for augmenting the human and institutional capacities of targeted Ghanaian institutions for improving service delivery to enhance economic growth" (College of Agriculture and Consumer Sciences (CACS), 2014). The project was implemented in the North East, Upper East, and Upper West regions of Ghana.

The farmers were introduced to biochar preparation, biochar compost preparation, biochar and biochar compost application to the soil, land preparation, planting in rows and at recommended spacing for maize, rice, and soybean, Harvesting and post-harvest handling of the produce. They were also trained in bookkeeping, pricing, and marketing. The farmers were supported with the construction of compost platforms for biochar compost preparation. They were also given Kilns for making biochar.

The rest of the FtF projects implemented in Ghana have been presented in appendix 4. In this study farmer participation in the USAID FtF capacity building and its influence on their innovative performance and productivity improvement to reduce poverty in northern Ghana was assessed.

1.3 Research Problem

To achieve the US Government FtF initiative's aim of improving economic opportunities, diversifying household income, reducing the prevalence of poverty and stunting by 20% (Lawson et al., 2016) in rural northern Ghana, several interventions have been implemented which include the four selected capacity building projects for this study. The collective goal of the capacity building projects is to improve the productivity of the three commodities (rice, soybeans, and maize) in an effort to reduce poverty in northern Ghana.

Estimates of yield gaps (between current and potential yields) in cereals is said to exceed 50% in low-income countries and highest (76%) in SSA and lowest (11%) in East Asia (FAO, 2017c). FAO indicates that potential for higher agricultural productivity is yet to be realised in SSA. Generally, Ghana's agricultural sector is characterised by low yields. For example, the yields of maize, soybeans, and rice are way below potential yields of 5.5Mt/ha, 3.0Mt/ha, and 6.0Mt/ha respectively (Table 1.1). Although high yields have been reported and attributed to activities of the capacity-building projects under study (Amponsah & Takyi, 2019; IFDC, 2018) it is not certain whether the reported yields have reached their potential.

The literature reveals that over the years continuous cropping of the land has led to poor soil fertility resulting in low agricultural productivity with crop yields below attainable national averages (Wood, 2013; Kermah et al., 2018). Yields have not reached even half of the potential (acceptable levels) except in the case of soybeans, which may be due to a lack of innovativeness on the part of the farmers. It may also be the case that although the farmers may have been trained, they might not be using the knowledge they have acquired at all or using it inappropriately, which is expected to give them a competitive advantage over non-participant farmers to improve productivity. Among the key challenges facing the Ghanaian agricultural sector is dwindling productivity resulting in low incomes, food insecurity, and poor well-being.

Table 1. 1 Yield levels of maize, soybeans, and rice by regions

	Average Yield of Selected Crops under Rain-fed Conditions						**Potential Yield (Mt/Ha)**
	2014	**2015**	**2016**	**2017**	**2018**	**2019**	
Maize							5.50
Northern	1.39	1.96	1.97	1.75	1.66	1.70	
Upper East	1.38	1.40	1.42	1.73	1.94	2.17	
Upper West	1.71	1.86	1.89	1.95	2.45	2.69	
Soya Beans							3.0
Northern	1.88	1.98	1.98	1.98	1.84	1.96	
Upper East	1.05	1.00	1.00	0.82	1.18	1.24	
Upper West	1.35	1.31	1.31	1.36	1.48	1.76	
Rice							6.0
Northern	2.12	2.23	2.30	2.40	2.01	2.02	
Upper East	2.62	2.78	2.83	2.65	2.78	2.97	
Upper West	1.43	1.48	1.54	1.57	2.26	2.94	

Source: MoFA facts and figures (2014 -2019)[1]

Although food insecurity reduced by half in Ghana by 2015, food insecurity still exists in some areas and is more severe in the north of the country (Ecker & Asselt, 2017). During the 2020 lean season, the World Food Programme noted that more than 21,000 people suffered from food insecurity in Ghana, particularly in the northern region (The Borgen Project, 2022). The Comprehensive Food Security and Vulnerability Analysis (CFSVA) conducted in Dec 2020 also revealed that those who are food insecure are about 12 percent with the most affected households found in the northern part of Ghana. Researchers from different disciplines have examined different aspects of well-being that

[1] Although there are new regions, yields were estimated for only the existing regions before the study.

include physical, economic, social, development and activity, emotional, psychological, and Life satisfaction. In northern Ghana where majority of the poor are found, well-being may be a mirage as a result of poor incomes derived from low productivity (Cotterell et al., 2008, Norsida & Sam, 2009; Muzari, 2016).

In northern Ghana, myriad factors are contributing to low productivity. These include erratic rainfall patterns, use of low yielding and uncertified seeds due to poor access to improved seeds, inadequate farmer knowledge about best farming practices, and low use of agricultural inputs (Yaro, 2013; Hasselberg, 2013; Akowuah & Boa, 2012; Ragasa et al., 2014; Poku, 2018; Adomako et al., 2020; Asodina et al., 2021). Key among the listed challenges that affect agricultural productivity is farmers' inadequate knowledge. According to Luangduangsitthideth et al. (2019), farmers' inadequate knowledge and poor perceptions about recommended technologies result in low adoption of such technologies. Therefore, the need to improve farmer knowledge cannot be overemphasised.

Available data from the Ghana Living Standard Survey (GLSS) indicate that poverty is still pervasive in this part of the country (GLSS, 2018) where agricultural-related activities are the main livelihoods of the people (Acheampong et al., 2018; GLSS, 2018). For example, in 2016/2017 the three regions together accounted for 67.2% of people living in extreme poverty in Ghana (GLSS, 2018). It is obvious from Fig 1.1, that in 2005/2006 poverty incidence was lowest in Greater Accra (13.5%) which declined consistently to 2.5% in 2016/2017. Similar trends could be observed for Central, Eastern, Ashanti, and Brong Ahafo regions except in the Western region. However, poverty incidence in northern Ghana (five regions) has consistently remained high over the same period although it declined in 2012/2013. There is a poverty gap between the northern and southern parts of Ghana with poverty incidence in the north higher than in the south.

Worth noting is the fact that farm-level constraints that hinder agricultural productivity may differ in space and time, and this requires farmers to be innovative and in certain situations self-reliant (Critchley & Nyagah 2000, as cited in Bertin et al., 2014). Usually, farmers innovate by reorienting technologies and practices introduced to them to suit their local conditions (Tambo & Wu, 2017). Chindime et al. (2017) posit that the level of innovativeness of farmers drives their performance for productivity improvement and for income increment. A study by Tambo and Wünscher (2018) revealed farmer innovativeness in northern Ghana to address productivity challenges.

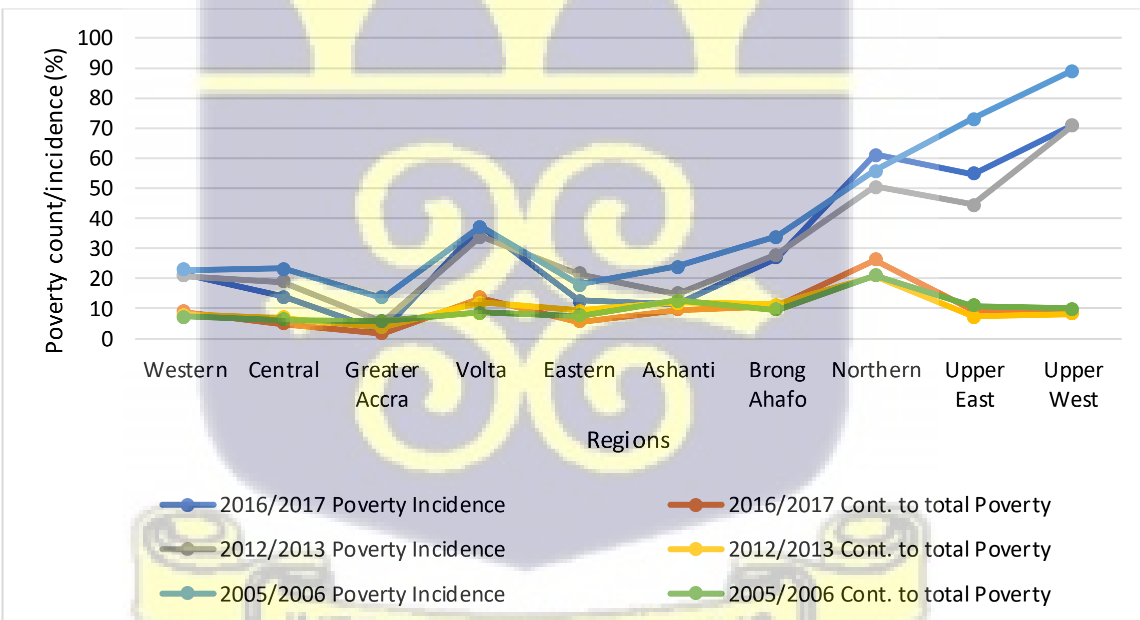

Fig. 1. 1 Poverty incidence and contribution (cont.) to total poverty by region, 2005/06–2016/17 (Source: GLSS 7, 2018)

Farmer innovative performance is important for improved productivity and competitiveness through the utilisation and sharing of information on knowledge (on technologies and practices) introduced to them (Chindime at el., 2017; Lappel et al, 2015; Meynard et al., 2017). There is therefore the need to investigate farmer innovative performance in terms of how resources, including the knowledge and skills acquired during the FtF capacity building activities, were either put to actual use or not and whether that has resulted in the reported yield increases.

Farmer participation in the capacity building activities of the selected projects is expected to enhance their knowledge acquisition and use thereby giving them competitive advantage in innovativeness to improve agricultural productivity and livelihood (Adebayo et al., 2017). Etwire et al. (2013) posit that farmers' participation in agricultural projects positively affects their livelihoods and ultimately helps in the effort to reduce poverty. When firms acquire, utilise and diffuse knowledge the firm's performance is enhanced (Jiang &` Li, 2009). Through participation in capacity building interventions, FBOs utilise the knowledge and skills and share information which is expected to improve their productivity. Therefore, whether the selected capacity building projects for this study will achieve their objectives or not will depend on farmers' effective participation in the capacity building activities of the various projects to acquire the relevant knowledge that will enhance their innovative performance to improve productivity, incomes, food security, and well-being.

Similar projects implemented in the past were unable to achieve their objectives due to several factors (Wood, 2013; Rutger, 2007). Given that most of the agricultural programmes aimed at developing technologies implemented in the past have not lived up to expectation (Freeman, 2014; Wood, 2013), it is necessary for stakeholders in the USAID FtF capacity building projects to find new ways of engagement that will enhance farmer participation in agricultural research and development to meet the needs of smallholder farmers (Muro & Jeffrey, 2008).

1.4 Research Questions

The main research question is how have farmers' participation in the selected USAID FtF capacity building projects implemented in northern Ghana enhanced poverty reduction?

The following are the specific research questions that this study seeks to address.

i. How have farmers' participation in the project interventions influenced their innovative performance?

ii. How does the innovative performance of farmers affect their crop productivity?

iii. What is the relationship between crop productivity and poverty reduction?

1.5 The research objectives

The main research objective is to ascertain how farmers' participation in the selected USAID FtF capacity building projects implemented in northern Ghana enhanced poverty reduction. The following specific objectives will address the research questions:

i. To determine the influence of farmer participation in the project activities on their innovative performance.

ii. To ascertain the effect of farmer innovative performance on crop productivity.

iii. To ascertain the relationship between crop productivity and income.

iv. To determine the relationship between crop productivity and food security

v. To determine the relationship between crop productivity and well-being.

1.6 Justification of the Study

Over the years several agricultural interventions have been implemented in northern Ghana in an attempt to address the issue of persistent poverty that has plagued that part of the country. There are suggestions that most of the interventions have not made the needed impact due to poor implementation and the fact that farmers lack the capacity to innovate or use technologies introduced to them to improve yield to desirable or acceptable levels. The result is persistent poverty in that part of the country.

The selected FtF projects for this study are either in their final stages of implementation or have been completed and therefore it is important to study them to learn so as to help improve the design of future projects and make them more effective. It is important to assess the influence of farmers' participation in the selected USAID FtF initiative capacity building projects on their innovative performance to see whether productivity has indeed improved as indicated in project reports. This will help funders to appreciate the impact of the projects in helping to reduce poverty in northern Ghana. The outcome of this assessment will inform project designs and future policies on actions and approaches to use in the development and implementation of agricultural interventions in northern Ghana and other places across the country to help address the SDGs in reducing poverty and hunger.

There is evidence that most development interventions rapidly fail due to lack of widespread adoption and maintenance. There is therefore the need to improve upon formal agricultural research and development and the additional criteria for effective implementation processes. Since funders are now deliberating on whether they should continue funding projects in sub-Saharan Africa, this study seeks to investigate the extent to which the selected capacity building projects have contributed to improvement in agricultural productivity and ultimately poverty reduction. This study will therefore be indicative of the effect of the capacity building activities on poverty reduction in northern Ghana. The study will also bring to the fore things that have worked as far as these projects are concerned that can be learnt to inform the design of poverty reduction projects in the future. It will also help bridge the knowledge gap as to the impact of the FtF Initiative in northern Ghana. It will also guide policy design and future intervention. The study will also add to the growing body of evidence of the potential impacts of agricultural interventions on agricultural development in northern Ghana.

1.7 Ethical Considerations

Ethical clearance was obtained from the Ethics Committee of the College of Basic and Applied Sciences before the field work involving the survey and focus group discussions. Project participating farmers who were willing to participate in the study were those from whom responses were elicited. This was done with due respect for their privacy.

1.8 Structure and Outline of the Thesis

The thesis is organised into seven main chapters. **Chapter One** presents the background which sets the tone for the thesis. It comprises the general background to the study, the problem statement, the research questions, the objectives of the study and its significance. The chapter also briefly discusses the USAID FtF Initiative capacity-building projects under study. It also defines the key terms of the study.

Chapter Two reviews literature related to the study and the theoretical underpinnings of the study. The conceptual framework is presented. Selected government agricultural policies have also been discussed. USAID FtF interventions in Ghana are also discussed. In doing this, the chapter traces the different interventions implemented in northern Ghana. The chapter summarises the findings of existing literature to address the research questions. It explores the effect of smallholder participation in agricultural interventions on their innovative performance, productivity, and the influence of productivity on incomes, food security and well-being. The chapter also helped in identifying variables in the study and the indicators used in measuring them. Lastly the chapter explores methodological approaches used in measuring the identified variables in the study.

Chapter Three is devoted to the methodology used to collect data for the study. The mixed design approach was used to collect primary data. Qualitative data was collected through field observation, one-on-one in-depth interview sessions and focused group discussion. Questionnaires were used to collect data from individual smallholder farmers. The study was carried out in at least two districts from each of the five regions of northern Ghana which has been the zone of influence of the USAID FtF Projects. Lastly the chapter presents the tools used for analysing the data.

Chapter Four This chapter presents the findings and discussions. **Subsection 4.1** presents findings of an investigation into how smallholder farmers' participation in the selected USAID FtF capacity-building projects' activities influenced their innovative performance. It begins by presenting and discussing the socio-economic characteristics of the respondents. It also discusses the levels of participation of respondents in the various projects as well as whether they exhibit innovative performance or not. Finally, how respondents' participation affected their innovative performance is explored and discussed. Quantitative data was used and analysed by using principal component analysis, cross-tabulations, and chi-square. Qualitative data was analysed and used to support some of the quantitative results and findings.

Subsection 4.2 presents findings of an investigation of the relationship between smallholder farmers' innovative performance after participation in the USAID Feed the Future capacity building activities and their crop productivity. It begins by presenting and discussing the individual effects of the projects on the yields of their participants. It further examines the relationship between innovative performance and the yields obtained by the project participants. Wilcoxon sign ranked test was used to test statistically significant difference in the yields of the crops before and after participation in the project activities. The Wilcoxon sign ranked test was used to test the statistically significant relationship between innovative performance and crop productivity.

Subsection 4.3 presents results and findings of the relationships between crop productivity and their income, food security and well-being. The chapter begins by presenting and discussing the yields of the three crops namely, maize, rice and soybean before and after the project. This is followed by results and discussions on the income before and after the project intervention. The Wilcoxon sign ranked test was used to analyse the difference in yield before and after the project and also income before and after the project. Ordinary least square regression was performed to show the relationship between crop yield and income of the farmers for each crop. The Kruskal-Wallis test was performed to identify relationship between crop productivity and food security and then crop productivity and the well-being of the farmers. Finally, qualitative data was analysed and used to support some of the quantitative results and findings.

Chapter Five This chapter summarises the findings made regarding the three research questions raised at the outset of the study. The chapter also presents the conclusions drawn from the findings as well as the recommendations made.

CHAPTER TWO

LITERATURE REVIEW

2.1 Introduction

This chapter explores agricultural development as a panacea to poverty in northern Ghana from the perspective of using participation in capacity building as a tool for increased productivity that is expected to lead to poverty reduction in northern Ghana. The literature review identifies the role of smallholder participation in agricultural research and development (R&D) as a way of ensuring their innovativeness in agriculture and offers explanations for these. Two theories that underpin the study are identified and the various concepts are also discussed in this chapter. The chapter also summarises the findings of existing literature to address the research questions.

2.2 Definition of Terms

According to the World Bank **poverty** is a state or condition in which a person or community lacks the financial resources and essentials for a minimum standard of living. In this study poverty is considered as low incomes, food insecurity and poor well-being.

The term "**capacity building"** has been defined differently by different authors over the years. The Organization for Economic Cooperation and Development (OECD, 2006:14) defined Capacity Building as: "the process whereby people, organizations and society as a whole unleash, strengthen, create, adapt and maintain capacity over time". The European Commission (EC, 2005: 5) defined Capacity Building as "the process by which people and organizations create and strengthen their capacity over time". The United Nations Development Program +-" The first two definitions focused on people and organisations and strengthening of capacity in general. However, the third definition incorporates setting and achieving goals. For the purposes of this study where both institutions and people are expected to use their capacities to sustainably set new goals and achieve them, the third definition will be adopted.

Social learning can be defined as learning through participatory schemes like groups, organisations, networks and communities, in conditions that are new, unexpected, uncertain, conflictive and unpredictable (Wildemeersch et al., 1998).

Innovative performance According to Perry-Smith and Shalley (2003) innovative performance often consists of "combining knowledge from different domains, that is domain knowledge". Odonkor (2004) posits that farmers' innovative performance entails changes expected to have occurred in farmers' knowledge, attitude and practices and skills and the socioeconomic effect of these changes on their productivity and management within their communities. Innovation performance signifies the ability to convert the inputs of the innovation into outputs, and at the same time transform such outputs into marketable products (Zizlavsky, 2016). It implies that when actors in a system e.g., farmers gain knowledge they should be able to apply the knowledge in ways that may enhance their livelihoods. Jokisaari and Vuori (2014) suggest that innovative performance should not only focus on the networks in which an individual belongs as a source of information but also focus on such an individual as a source of information to others. It is likely when people give information to others, they also acquire some knowledge from others in the course of the exchange of information, which then supports their innovative performance. In this study farmer innovative performance is defined as farmer's utilisation and sharing of information on knowledge and skills acquired through participation in capacity building.

Productivity is commonly defined as "a ratio measure of output volume and the volume of inputs" (OECD, 2001). According to (Mozumdar, 2012) productivity measures are used for different purposes. As an example, yield or land productivity is usually used to evaluate the success of new technology. In this study productivity is considered as yield (kg) per hectare (Land Productivity).

Food security exists when all people, at all times, have physical and economic access to sufficient safe and nutritious food that meets their dietary needs and food preferences for an active and healthy life (World Food Summit, 1996). The study focused on availability aspect of food security.

Well-being is defined by the Canadian Index of Wellbeing as "the presence of the highest possible quality of life in its full breadth of expression focused on but not necessarily exclusive to: good living standards, robust health, a sustainable environment, vital communities, an educated populace, balanced time use, high levels of democratic participation, and access to and participation in leisure and culture" Drabsch (2012).

Similarly, the French Commission on Economic Performance and Social Progress defined wellbeing as "involving the simultaneous consideration of dimensions of: material living standards (income, consumption, and wealth); health; education; personal activities including work; political voice and governance; social connections and relationships;

environment (present and future conditions); and insecurity, of an economic as well as a physical nature". In this study well-being is considered as general satisfaction with life in terms of economic empowerment.

2.3 Theoretical framework

During the literature review, the social learning theory and the knowledge-based theory were identified and that underpinned this study.

2.3.1 Social Learning (SL) theory

According to Bandura (1977) "Learning would be exceedingly laborious, not to mention hazardous, if people had to rely solely on the effects of their own actions to inform them what to do. The social learning theory emphasizes the importance of observing and modelling the behaviours, attitudes, and emotional reactions of others". Bousquet and Voinov (2010) posit that participatory social process to promote social learning. At the same time, theories of SL are useful tools that inform the design of participatory processes Schusler et al, 2003). Miller and Dollard (1941) on a psychological and pedagogical level attempted to define SL and expound a theory by suggesting that individuals after observing other peoples' behaviour, in their cognitive transformative processes implement that behaviour based on the benefits or rewards or any form of incentive associated with that behaviour. This opened a flood gate of many SL theories of which Bandura's was considered to be all-inclusive (Kihlstrom & Harackiewicz, 1990). Bandura's theory of social learning shows the importance of observing others and mimicking them (Nabavi, 2012). Barrantes & Yagüe (2015) opined that SL is effective for sustainable adult learning and innovation.

Social learning was presented as an alternative to the initial thinking that the linear approach was the way to go when it came to development, however it rather opened up the debate that learning through interactions and interdependence of multi-stakeholders is desirable for the future (Leeuwis, & Pyburn, 2002). Khan et al. (2022) suggested that interdependence provides opportunities for the creation of new knowledge, increased information and experience sharing and closer collaborations through active learning. According to Röling and Jiggins (1998) SL is a theory that informs intervention (practice) and is characterized by interactions or participatory ways through which problems are addressed with facilitation serving as a catalyst. They further explain that the interactive nature of SL is observed based on joint learning, resolving conflicts within interactive processes, negotiation, converging goals, theories, and systems of monitoring and concerted action. Marques et al. (2020) indicated that actors' involvement in SL processes increased their confidence, knowledge, and capabilities to improve productivity.

It is not clear how the USAID FtF Capacity Building Projects are shaped to fully utilize the tenets of social learning to make a maximum impact of improving agricultural productivity in northern Ghana which will eventually alleviate poverty. There are certain factors that either enhance or impede SL processes. The factors considered key for the creation of learning environment are representativeness, facilitation, opportunities for openness and interaction (Mostert et al., 2007). Another factor of essence that promotes learning is bringing multiple actors with different perspective together for constructive knowledge exchanges (Schusler et al., 2003). Factors identified that limit/hinder social learning are limited resources and time (Mostert et al., 2007).

Muro and Jeffrey (2008) indicated that the main tenets of SL models are a process in which there is joint or interactive and communicative learning that result in outcomes such as new skills, knowledge, development of trust and relationships, common understanding of the challenge faced, agreement and collective action (Figure 2.1). This enables group consensus building on issues when individual goals are recognised as part of the whole.

Under the capacity building activities of the various projects, social learning has a role to play in activities such as field demonstration where farmers observe, learn, and communicate freely with each other and decide to try the innovations either through experimentation or directly on their farms. A review of the SL theory revealed that people and, in this study, farmers must first participate in interactive processes, acquire a set of knowledge and skills agreed upon through collective decision and action (practice) to solve challenges they face.

The key variables identified are therefore, knowledge acquisition, its utilisation and possible sharing, and collaborations to solve challenges (social action) such as attracting resources and making resources available to help the community.

2.3.2 Knowledge based theory

The knowledge-based theory of the firm considers knowledge as the most strategically significant resource of a firm. This knowledge is embedded and carried through multiple entities including organizational culture and identity, policies, routines, documents, systems, and employees.

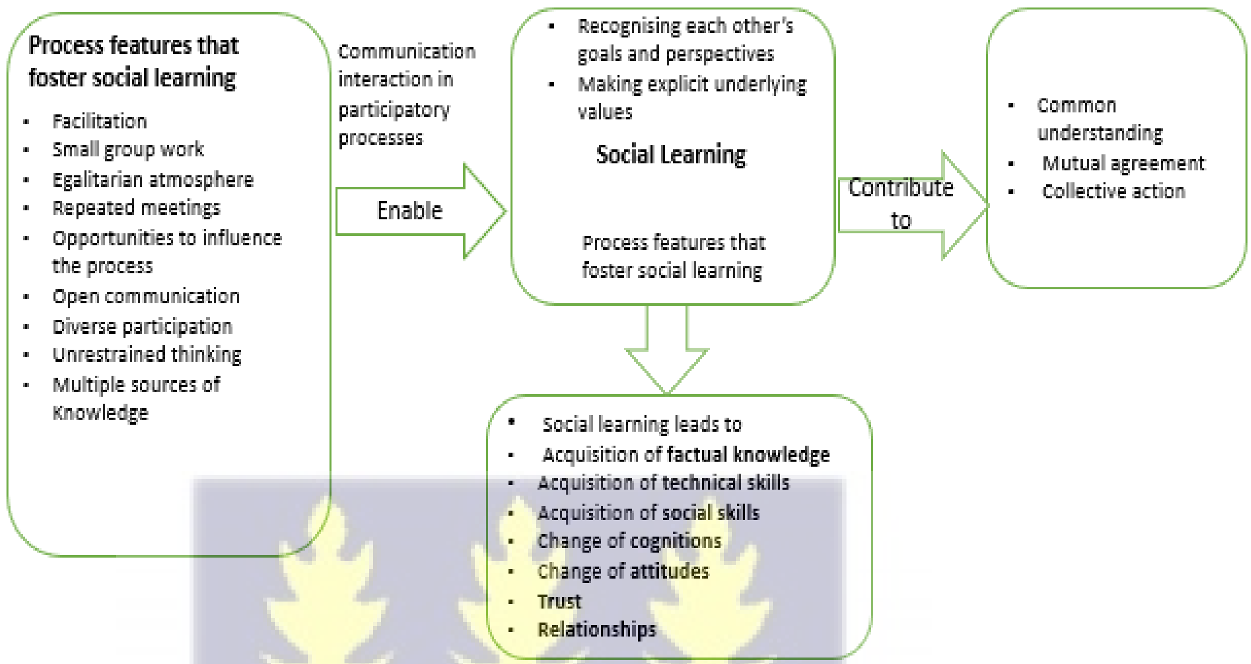

Fig. 2. 1 A compound model of social learning adapted from Muro and Jeffrey (2008)

The knowledge-based view of the firm is a recent extension of the resource base view (RBV) of the firm (De Carolis, 2002). RBV focuses on the resources and capabilities inside the firm as determinants of the firm's profit and value of the firm (Grant, 1991). According to Hoopes et al. (2003) this theory is used to explain differences in performance within an industry with several firms. These differences in performance could be attributed to the valuable resources that an organization possesses that other firms do not have. On the other hand, knowledge is perceived as the most important strategic resource under the Knowledge Based Theory (KBV) (De Carolis, 2002). Knowledge as a firm's resource is important in ensuring competitive advantage and sustainability. This is because resources such as knowledge are not easily imitated and form the foundation for sustainable differentiation (Wiklund & Shepherd, 2003). Knowledge asymmetries forms the basis of differences in the performance of organisations and as a result the KBV of the firm proposes that the organization exists to create, transfer, and transform knowledge into competitive advantage (Kogut & Zander, 1992, as cited in Burt, 2004). Therefore, in order for firms/organisations to be competitive in today's economy it is imperative for them to become knowledge based. In the case of the USAID FtF Initiatives, the individual farmer's farms can be considered as firms or enterprises that could be knowledge based if their capacity is built to enhance their knowledge that will make them gain competitive advantage over farmers' whose capacities have not been built.

In order to improve agricultural productivity in northern Ghana it is important to build the capacity of the farmers so that they are able to innovative and generate new knowledge which they can use to address the numerous challenges they go through in their production processes. The key variables identified during the review of the knowledge-based theory are, knowledge, its transfer, farmers' competitive advantage in terms of improved yields, improved incomes, food security and well-being.

This section of the literature review helped to identify the relevant variables in the theories underpinning this study. The variables include participation in group activities for effective learning and concerted action, knowledge acquisition, its utilisation and sharing which constitute the indicators of innovative performance in this study.

2.3.3 Relationship between the theoretical framework and farmer participation and innovative performance

Participation in research and development is one way in which smallholder farmers can break away from the poverty cycle. This is because through participation smallholder farmers acquire knowledge and utilise the knowledge and, in the process, share the knowledge to affect the larger community in which they live. The more people utilise and share such knowledge the more enhanced their innovative performance and this may lead to increased incomes, food security, and well-being.

Social learning involves adult learning from experience. Through participation in group activities such as field demonstrations, individual farmers learn from each other. In the process they build relationships, friendship, and trust. They are then able to take collective decisions and find solutions to challenges they face in their farming endeavours. During group activities such as field demonstrations, farmers engage in interactive activities through which they acquire knowledge thereby gaining competitive advantage over those who do not participate in such group activities.

The trust and friendship they build amongst themselves enable them to share their knowledge and experiences which may be as a result of their own experimentation. Farmers are known to trust their fellow farmers' information therefore, enhancing farmer to famer extension. In this study innovative performance is considered as farmers' utilisation and information sharing of their knowledge and skills acquired from participation in project activities.

2.3.4 The links between social learning and innovation

Hargadon (2002) posits that existing knowledge within organisations serve as raw materials for innovation within those organisations. The links between such knowledge and the innovations that emerge are said to occur within a social context where it takes place. Hargadon further indicates that there are suggestions from some researchers that firms that cut across multiple domains may innovate by moving ideas within certain domains where they are known to unknown domains, in the process creating new combinations of existing ideas.

Hargadon (2002) explains that to innovate, problem solvers (farmers) should be able to apply knowledge learned in a particular domain to another and observe the value of that knowledge and this involves experimentation. According to George (2007), the ability of individuals to propose innovative ideas depends to a large extent on the social environment. It has been argued that the social environment is an important source of knowledge, advice, and encouragement for the development of innovative ideas (European Commission, 2014).

An important characteristic of the social network is how its members are connected. Jokisaari and Vuori (2014) argue that in considering innovative performance, the focus should move from seeing networks as information sources to considering how an individual could serve as a source of information to others. In a study to analyse the impact of the PEDUNE/PRONAF Cowpea project on farmers' innovative performance in Northern Ghana, Odonkor (2004) found out that farmers trained under the Farmer Field School (FFS) programme engaged in experiments that served as sources of information for further research by researchers. A similar observation was made by (Leitgeb, 2011). Farmers also applied the knowledge acquired in the FFS in the cultivation of other crops.

2.4 Conceptual framework

The conceptual framework depicted in Fig 2.2 is the logic model (LM), adopted from literature. It presents how the projects could be assessed to ascertain how by its very design the projects can achieve their goals or not.

Knowlton and Phillips (2013) in a description of the application of the logic model in planning and evaluation processes described it as a tool that provides the basis for identifying and measuring the outcomes of projects. According to Kellogg (2004) the logic model is a visual presentation that depicts relationships that exist within available resources required for use in a programme, the planned activities and the changes or expected results one hopes to achieve. It describes the ways in which activities are sequenced that result in the expected results. Anderson et al. (2011) explained that LMs establish the links between the components of a project that results in outcomes. In effect LMs enable programme implementers to identify the causal factors of certain outcomes. In the same vein Savaya and Waysman (2005) indicated that the logic model is important when it comes to connecting theory to practice and outcomes during the evaluation of programmes.

LM further helps to identify the specific project components and discusses the inputs required to undertake specific activities, the activities to be undertaken, outputs for the activities undertaken, the outcomes, and the factors and assumptions shown in Fig 2.2.

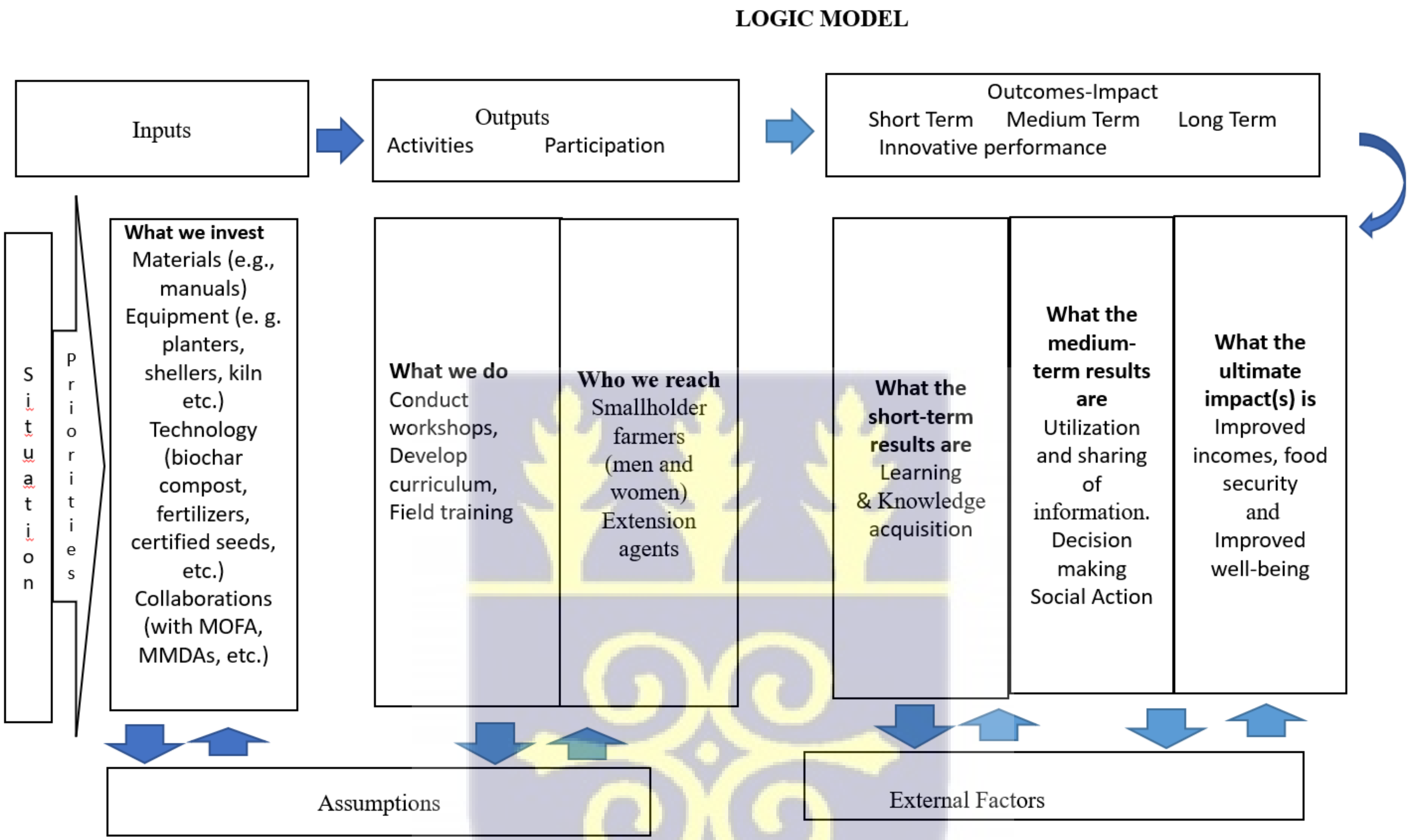

Fig. 2. 2 A Logic Model adapted from Enhancing programme performance with logic models, University of Wisconsin-Extension, February 2003

In a study to evaluate large research initiatives Trochim et al. (2008) developed and used the logic model to identify the variables that needed to be measured and for integrating various qualitative and quantitative data that resulted. According to them, the logic model serves as a key device for organizing and grouping results from multiple approaches that result in each outcome area and enables such outcomes to be synthesised into findings. This helped them to categorise the results into short term, medium-term and long term. In effect, the logic model served as a framework for developing questions for the evaluation (Trochim et al., 2008).

In this study the LM was employed to understand the activities, outputs, and outcomes of the different projects to be able to assess them effectively. During project implementation inputs are used to undertake specific activities which result in certain outcomes both desirable and undesirable as well as intended and unintended. According to Coryn et al. (2011) the inputs include the various resources needed to implement the project. In this study the inputs include materials such as manuals, equipment (e. g. planters, shellers, kilns, etc.), technologies (biochar compost, fertilizers, certified seeds, etc), collaborations with MoFA, Metropolitan, Municipal, and District Assemblies (MMDAs) and their interactions during project implementation. The activities may include curriculum development, training workshops, and field trainings to attain certain results. The output is the immediate results of actions taken such as the number of trainings, and the number of people trained or who received the services. Farmers' participation in the activities such as meetings, group activities and the field demonstration is expected to influence their innovativeness through learning and acquisition of knowledge which they may utilise and share with other farmers to produce certain outcomes. The outcomes are the expected changes that may occur directly or indirectly as a result of the use of inputs to perform certain activities and outputs that are generated. These outcomes include (changes in knowledge, and practices, or level of functioning that are exhibited at the level of the farmer). These outcomes could be classified into short-term, medium-term, and long-term (Fig 2.2). For this study short-term outcomes include learning and acquisition of knowledge, the medium-term outcomes are the utilisation and sharing of knowledge, decision making after experimentation and the actions (social action) that are taken to address challenges such as attracting resources to the communities and making resources available to aid the communities (Innovative Performance) that eventually produce long-term outcomes such as improved incomes after participation in project activities (sale of crop outputs), food security as in the availability of food especially during the lean season (extended time e.g. number of months of food availability before the next season) and improved well-being as in farmers' satisfaction with life as suggested by Stone (2014) and their ability to pay school fees, attend hospital, buy household items, start a new shop and expend their farms etc.

The impacts of interventions could be levels of changes at the organizational, community, and/or system level, as a result of program activities. These may include increased capacity, improved conditions, and/or changes in the policy arena (Kellogg, 2004).

Assumptions and external factors also form very important components of the LM. The assumptions are the beliefs about the program or intervention in this case the USAID FtF initiative projects and the resources involved. The assumptions about how the project will work, that is the "theory" that was used to develop the program or intervention. These assumptions may be based on research, best practices, experience, and common sense that may inform the decision made about implementing a program or intervention. These may include:

- Availability of funding throughout the project.
- The technology will be adopted and used in the way intended.
- Professionals will be motivated to conduct learning sessions.
- External funds and well-placed change agents can facilitate institutional change.
- Staff with the necessary skills and abilities can be recruited and hired.
- Partnerships or coalitions can effectively address problems or reach into areas we cannot.

The external factors in the LM include the environment in which the project exists and the interacting external factors that may influence the project or intervention either positively or negatively. These factors are crucial and determine project implementation, participation, and the achievement of project goals. Project implementors usually do not have control over such factors that could affect the success of the project, such as weather (rainfall), pests and diseases, institutional bottlenecks, community unrest, and public policies.

The theoretical and conceptual framework helped in the identification of variables and concepts and the indicators used in measuring them.

2.5 Poverty reduction through Ghana's development agenda: A historical perspective

Agriculture has remained a singular sector in the fight against poverty and the economic growth of most developing economies especially SSA (Corral et al., 2017). The sector contributes significantly to developing countries Gross Domestic Product (GDP). Therefore, developing countries' development agenda could be traced to the type of agricultural policies that have been pursued over time.

In Ghana agricultural policies date back to the colonial era and were initially focused on the promotion of mainly industrial crops such as cocoa and oil palm meant for export. The focus was on making the then Gold Coast a source of industrial raw material for the manufacturing industries in Europe (Asuming-Brempong, 2013). The passing of the poll tax law by the colonial administration caused farmers to move into cash crop production, mainly cocoa. This transformed Ghana into the world-leading cocoa producer from 1911. Ghana, therefore, became a prosperous nation as compared to other African countries due to the export-led growth of the country at the time (Asuming-Brempong, 2013).

After Ghana attained independence the major policy focus was the modernization of Agriculture to support the expanding economy at the time (Dzanku & Aidam, 2015). This led to the establishment of the Agricultural Development Corporation to spearhead the modernisation agenda. The state's intervention in the agricultural sector in 1961 through state farms was said to be a socialist ideology at the time. The intervention hinged on large-scale production units but were said to be disappointing (Asuming-Brempong, 2013). After the 1966 coup the socialist ideology pursued by the then government under Dr. Kwame Nkrumah was abandoned and the military, as well as subsequent civilian governments, adopted a capitalist development of agriculture in Ghana. This led to the formation of single commodity development boards for cotton and grains. According to Yaro (2013) a green revolution sparked the introduction of improved crop varieties, infusion of capital, the strengthening of the agricultural extension system as well as land redistribution. However, due to a breakdown in the socialist structures resulted in civil servants and a few elites benefiting through loan disbursement to the educated elite and co-opted chiefs.

The Agricultural Development Bank (ADB) was also established as a Development Bank by an Act of Parliament (Act 286) in 1965 under the name Agricultural Credit and Cooperative Bank before its name was later changed in 1968 to ensure adequate credit support for the agricultural sector in order to promote agriculture (Yaro, 2013). Some challenges the bank encountered include the fact that management of some projects lacked the needed capacity to utilize the funds allocated leading to no disbursement of some donor funds at the end of these projects. For example, there was lack of technical capacity in delivering agricultural credit. Apart from management problems there were other challenges that constrained the achievement of the bank's objectives. These include lack of innovation on the part of farmers and risk mitigating measures as well as technical capacity to transform agriculture (Asiamah, 2015).

The government at the time invested in rural development schemes such as roads, water, and electricity as a way of encouraging the rural folks to stay and work on their farms. From the 1970s this policy was abandoned by the governments that followed which led to the decline in agricultural production. A rural development programme implemented between 1969 and 1972, Rural infrastructure development and the promotion of agriculture targeted rural infrastructure development and the promotion of agriculture. It is important to note that various policies have been implemented and this section of the thesis reviews projects and policies that have contributed to poverty reduction over the years.

2.5.1 Key projects and policies of the government of Ghana directed at poverty reduction

A Policy is said to be "a course of action designed to achieve certain goals or targets by a government, implemented through organisations and institutions to achieve particular outcomes" (DFID, 2001 as cited in Gyenfie, 2014: 59). Gyenfi (2014) indicated that the two ways in which livelihoods could be impacted by the formulation and implementation of public policy are

- "Changing institutions to be more or less supportive of poor people's livelihoods and

- changing institutions to alter the incentive measures for organisations and how it relates with poor people".

The following section will discuss key agricultural policies that have been implemented in Ghana.

2.5.1.1 Operation Feed Yourself and "Operation Feed Your Industries" between 1972 and 1974

The problem of food shortages coupled with high prices in the 1970's led to the institution of the "Operation Feed Yourself and "Operation Feed Your Industries", a national self-reliance programme for increased food production (Girdner et al., 1980). According to (Seini, 2002) the immense interest in raising agricultural productivity in Ghana to self-sufficiency brought about Operation Feed Yourself (OFY) and Operation Feed Your Industries (OFYI) programmes after 1972. He further elaborated that OFY and OFYI were to spearhead the effort to increase food production and agricultural industrial raw materials such as sugar cane, cotton and Kenaf. Through OFY and OFYI Ghana became self-sufficient in rice production between 1974 and 1975 (Seini, 2002).

The whole idea was to increase agricultural production and provide the needed raw material for the local industries which operated at low capacities then. However, policies such as price control and guaranteed minimum prices set for rice, maize, and cocoa could not help the decline in agricultural production at the time. This situation was attributed to heavy taxes imposed on agriculture at the time coupled with unfavourable weather conditions and low prices of commodities (Asuming-Brempong, 2013).

Operation feed yourself was characterised by poor implementation. There was a misapplication of disbursed funds meant to support farmers which resulted in the discontinuation of disbursement loans to cooperation by ADB. For example, loans meant for the purchase of farm inputs and equipment were diverted to other areas which did not have direct bearing on production. Also, lack of coordination between research institutions, the universities, and MOFA led to poor dissemination of research results to farmers. It was mainly commercial farmers who produced for export, who benefitted from the services of the extension workers to the detriment of food crop farmers who could not afford to buy inputs such as fertilizers, insecticides, and knapsacks (pumping machines) (Girdner et al., 1980).

2.5.1.2 The Fertilizer Subsidy Programme (FSP)

Given that the soils in Ghana are deficient in nutrients, there is an attendant effect on crop yields with losses estimated at 30% to 80 % of achievable yields. Such low yields pose a threat to household food security and reduce the income levels of food crop farmers (MoFA, 2013). Over the years fertilizers have served as a means to address soil infertility and soil nutrient deficiency. However, farmers in Ghana and especially the northern part of the country can hardly afford to buy and use fertilizers. It is argued that FSP was a more favourable way to incentivise farmers to improve crop productivity. As a result, many Sub-Saharan African countries embarked on the FSP from the 1960s through the 1980s to improve agricultural productivity (Dorward, 2009). However, due to the structural adjustment programme and market liberalisation in the 80s and 90s FSP was suspended in Africa which affected the programme in Ghana (Cotterell et al., 2008).

In Ghana, the FSP was an important programme of the Government and was pursued through MOFA to boost agriculture productivity with a primary objective of attaining national self-sufficiency and food security through the provision of subsidized inputs. The suspension of the programme took a toll on productivity as a result of the decline in soil fertility leading to low production and the subsequent effect on food security (Mabe et al., 2018). The Africa Fertilizer Summit was organised in Abuja in 2006 to address the situation and that led to the "Abuja Declaration on Fertilizer for Green Revolution". The declaration resolved to increase the application of fertilizer to 50 kg/ha by member states by 2015 (AU, 2006). It was therefore proposed that 10% of the country's national budget should be invested in fertilizer subsidy to increase productivity by 6%. As a result, the government of Ghana re-introduced the fertilizer subsidy programme in July 2008 to boost production and productivity in line with its commitment to reducing food insecurity and improving the standard of living of the rural livelihoods (Banful, 2009). The programme subsidized crop farmers and covered about 50 percent of the prices of fertilizer (MOFA, 2013).

A study by Wiredu et al. (2015) indicated that the FSP in Ghana led to an increase in land productivity. However, the FSP faced challenges such as the hoarding of fertilizer by farmers and politicians (Baltzer & Hansen, 2012, as cited in Mabe et al., 2018). This led to a high level of dissatisfaction with access to subsidized fertilizer in Ghana. A study by Yawson et al. (2010) revealed that there was late arrival of the fertilizers and also a lack of technical support and extension advice on good agricultural practices. Although the programme succeeded in increased input utilization and boosting agricultural productivity, it was marred with high administrative costs and political manipulation (Banful, 2010).

2.5.1.3 Medium-Term Agricultural Development Programme (MTADP)

Medium-Term Agricultural Development Programme (MTADP) was initiated in 1988 and launched in 1991 (Seini, 2002) against the backdrop that Ghana lacked a comprehensive policy framework. MTADP covered the period 1991 to 2000. According to Dzanku and Aidam (2015:104), the broad aim of MTADP was to "promote institutional reforms required for increased investments and market-oriented agricultural growth with an emphasis on private sector participation in various segments of the agriculture value chain". The objective was to define a programme of policy and institutional reforms, and a complementary set of investments needed to achieve a higher growth rate at a sustained annual growth in agricultural GDP of about 4% (Asuming-Brempong, 2013). MTADP proposed an increase in private sector participation in agricultural marketing, pricing, and the liberalization of the supply of seed, fertilizer, and other agricultural inputs. Due to the implementation of MTADP, between 1994 and 1977 food production was revived in a sustainable manner such that population increases did not affect food security at the time. Sustainable food production had a positive effect on rural and overall income, nutrition, and poverty levels. There was also a remarkable growth in the export of fruit and vegetables while traditional export and industrial crops performance was less positive (Asuming-Brempong, 2013).

2.5.1.4 Food and Agricultural Development Policy (FASDEP)

FASDEP was the first comprehensive policy of the Government of Ghana and was implemented through MoFA. There are two phases of FASDEP namely FASDEP I and FASDEP II. According to Dzanku & Aidam (2015), FASDEP was developed in 2002 as a framework to modernise the agricultural industry in Ghana. FASDEP was to provide a framework to guide the implementation of agriculture sector objectives which were contained in the Ghana Poverty Reduction Strategy I. FASDEP hinged essentially on the critical elements of the Accelerated Agriculture Growth and Development Strategy (AAGDS) which were prepared in 1996 and instituted as a decade-long policy framework with a focus on strengthening the private sector as the engine of growth (Dzanku & Aidam, 2015).

Dzanku and Aidam (2015) further indicated that a poverty and social impact analysis of FASDEP in 2006 revealed certain shortcomings which led to the development of FASDEP II in 2007 through to 2015. The shortcomings identified include:

- “poor targeting of programme beneficiaries due to failure to account for their peculiar circumstances
- weak problem analysis resulting from the insufficient involvement of beneficiaries and the lack of proper coordination among relevant ministries, departments, and agencies” (Dzanku & Aidam, 2015: 107)

FASDEP II focused on sustainable utilisation of resources, commercialization of activities, and market-driven growth. FASDEP II was to serve as the framework for a relatively longer-term policy agenda of achieving the agricultural sector component of GPRS II. FASDEP II had six components namely:

- food security and emergency preparedness
- improved growth in incomes.
- increased competitiveness and enhanced integration into domestic and international markets
- sustainable management of land and environment
- science and technology application in food and agriculture development; and
- improved institutional coordination (Dzanku & Aidam, 2015: 107).

Key strategies include accelerating the provision of irrigation infrastructure, enhancing access to credit and inputs, promoting selective crop development, and increasing access to extension services (Dzanku & Aidam, 2015).

2.5.1.5 Medium-Term Agriculture Sector Investment Plan (METASIP)

Based on the Maputo and Malabo declarations to make the government of Ghana allocate 10% of GDP to the agricultural sector with an expected 6% growth in GDP, the METASIP

I which spanned from 2011 to 2015 and METASIP II from 2014 to 2017 were born out of FASDEP II.

Although FASDEP II continues to be the long-term policy framework for the agriculture sector, METASIP was developed taking into account relevant regional and sub-regional policies, namely the ECOWAS Agriculture Policy and the Comprehensive Africa Agriculture Development Programme (ECOWAS/CAADP). The targets of METASIP are to

- achieve an annual sectoral growth rate of 6 percent, and
- reduce by half the number of people living in poverty by 2015 (the first target set in the Millennium Development Goals).

According to Dzanku and Aidam (2015) the following are some of the programmes under FASDEP II/METASIP

- Food security and emergency preparedness
- Increased growth in incomes
- Competitiveness and enhanced market integration
- Sustainable management of land and environment
- Application of Science and Technology to Agriculture
- Institutional coordination

METASIP was a medium-term investment plan which sought to make the country food secure by 2015 (MOFA, 2010). METASIP provided an integrated investment framework to support growth in the agricultural sector, rural development, and food security (MoFA, 2007).

The METASIP was intended to implement the six programmes outlined in FASDEP II. These include

- Food security and emergency preparedness
- improved growth in incomes
- increased competitiveness and enhanced integration into domestic and international markets
- sustainable management of land and environment
- science and technology applied in food and agriculture development and
- improved institutional coordination.

The METASIP was expected to contribute to the achievement of the Millennium Development Goals targets. It is important to mention that the primary stakeholders of these agricultural policy documents are the MoFA, the Council for Scientific and Industrial Research, academia, civil societies, farmers, and non-farm operators, etc. MoFA was to champion the implementation of these programmes.

2.5.1.6 Planting for Food and Jobs (PFJ) programme

Although these policies and programmes have been implemented over several decades with some successes and failures, there are still challenges with Ghana's agricultural sector such as smallholder access to market and post-harvest management. According to Mabe et al. (2018), these challenges were to be addressed through the launching of PFJ in April 2017. The primary objective of PFJ is to motivate farmers to increase their crop productivity by improving access to both inputs and output markets, the creation of employment opportunities in the agricultural value chain. The programme seeks to enhance food crop productivity through the provision of services in marketing as well as production (Mabe et al., 2018). The primary objectives of the programme are farmer motivation for crop productivity improvement and job creation in the agricultural sector. The specific objectives include:

- To ensure self-sufficiency by improving productivity and intensifying the cultivation of some selected food crops.

- To provide employment opportunities (both formal and informal) to unemployed persons, especially the youth in agriculture and its related sectors.

- To create general awareness of the significance of having farms and backyard gardens for the cultivation of cereals and vegetables.

The programme combines agricultural extension services with the provision of subsidized inputs to farmers to enhance productivity. The programme is also intended to provide the framework for agricultural value chain development that will enable the private sector to engage the farmers (MoFA, 2017). PFJ forms part of the Modernization of Agriculture in Ghana (MAG) Project, which MoFA is implementing to reverse the declining growth of the agriculture sector (MoFA, 2017). The PFJ programme covers five pillars, namely, (i) provision of subsidized and improved seeds; (ii) subsidized fertilizer; (iii) agricultural extension services; (iv) establishment of markets; and (v) e-agriculture.

These pillars target increases in maize, rice, and soybean 30%, 49%, 25% respectively. (Ministry of Finance and Economic Planning (MFEP), 2017). Specifically, PFJ aims at increasing the yields of maize, rice and soybean from the current figures of 1.7 Mt/Ha, 2.7 Mt/Ha and 1.7 Mt/Ha to 5 Mt/Ha, 4 Mt/Ha and 5 Mt/Ha respectively at the end of the fourth year of implementation (Mabe et al., 2018)

An assessment of the PFJ by Mabe et al. (2018) revealed some challenges. It was reported that inadequate quantities of fertilizers and seeds were identified as a major challenge that the programme faced. Political interference and lack of support from Municipal and District Assemblies as well as smuggling and reselling of inputs led to inadequate supply of inputs to farmers. Some seeds like rice that were supplied were of low quality. Some seeds were also labelled in French so the farmers could not read and understand. The mode of payment for inputs was cumbersome and there was also a general lack of information about the PFJ.

2.5.1.7 National Agriculture Investment Plan (IFJ)

The National Agriculture Investment Plan (NAIP) or Investing for Food and Jobs (IFJ) has been developed with the aim of addressing issues bothering on biodiversity, climate change and environmental management, gender equity, poverty, inequality, agricultural employment, food and nutrition security and social protection. Its development is in line with global (SDGs), continental Comprehensive Africa Agriculture Development Programme (CAADP), Malabo and (ECOWAP) development frameworks. IFJ is an agenda developed to transform Ghana's Agriculture and operationalise the vision of the

Government of Ghana according to the Medium-Term National Development Policy Framework (MTNDPF) which is titled "*Agenda for Jobs: Creating Prosperity and Equal Opportunity for All (2018-2021)*". The IFJ is designed to address the challenges identified with the METASIP I & II and a framework to stimulate the modernisation of the sector through the Government's flagship programmes including the Planting for Food and Jobs, Planting for Export and Rural Development, Rearing for Food and Jobs, One-District-One Factory, One-District One-Warehouse, among others, based on the adopted objectives and key strategies from the Agenda for Jobs (2018-2021). The transformed agricultural sector is expected to open up the potentials to increase incomes, create jobs and provide raw materials to industry with a strong focus on creating an enabling environment for private sector operators and other actors within the various commodity value chains (MoFA, 2018).

2.6 Development Partners' Interventions in Ghana

Over the years development partners have played various roles in the socio-economic development of Ghana through budgetary support, projects/programmes, and technical assistance for poverty alleviation. After years of such support, the Fourth High Level Forum on Aid Effectiveness/HLF4, held in South Korea in 2011, identified capacity development and support as key to further development assistance in partner countries. HLF4 was preceded by a High-Level Forum in Paris in 2005 (with a prelude in Rome in 2003) and followed by the Accra Forum in 2008. HLF4 marked a new era in international development co-operation as expressed in the forum declaration, *The Busan Partnership for Effective Development Co-operation* (Organization for Economic Development, 2011).

Following these declarations, the government of Ghana and its development partners have launched several initiatives to address poverty through collaborations with government agencies, civil society, farmers' organizations, the corporate private sector, academia, and research institutions.

2.6.1 International Fund for Agricultural development (IFAD)

An overarching objective of IFAD is to reduce poverty in line with the government's economic development strategy and therefore it has concentrated its interventions in northern Ghana and supported some programmes such as the Ghana Agricultural Sector Investment Programme (GASIP), the Rural Enterprises Programme (REP), the Rural and Agricultural Finance Programme (RAFiP), and the Northern Rural Growth Programme (NRGP) among other interventions. Some of IFADS's completed programmes include the Root and Tuber Improvement and Marketing Programme (RTIMP) which directly benefited 180,000 households, the Rural Enterprises Project – Phase II which also directly benefited 80,000 households, the Northern Region Poverty Reduction Programme directly benefiting 280,000 households and the Rural Financial Services Project also directly benefiting 330,000 households (IFAD, 2015).

2.6.2 Food and Agricultural Organisation (FAO)

FAO's assistance to Ghana's economic growth has focused on sustainable improvements in agricultural production; sustainable management of the environment and natural resources; and building resilient communities for rural poverty reduction (FAO, 2021). Capacity development forms part of FAO's core mandate and their overarching goal has been to contribute to the development of livelihoods and the economy at large through the strengthening of national systems and institutions for example, by supporting the 2018-2021 Ghana Agricultural Investment Plan among other policies and initiatives. FAO is supporting programmes such as “Planting for Food and Jobs” and “One District on factory”. To bridge the gap between agricultural finance demand and supply, FAO is also supporting the Banks, Government, and traditional and non-traditional financial institutions in providing practical advice and innovative platforms to help develop innovative financing solutions for farmers. The FAO-managed Africa Solidarity Trust Fund (ASTF), which supports agribusiness employment opportunities for the youth through the development of sustainable aquaculture systems and cassava value chains, is one of the programmes being used to catalyse economic growth (FAO, 2021).

2.6.3 Deutsche Gesellschaft für Internationale Zusammenarbeit (GIZ)

The experiences of GIZ in Ghana cover the areas of economic development and employment promotion, energy and the environment, and peace and security. Currently GIZ is implementing a project titled “Sustainable Employment through Agribusiness (AgriBiz)”. The objective is to create conditions for productive employment in micro, small and medium-sized enterprises (MSMEs) in the agribusiness space. AgriBiz supports the processing companies in their business development, by introducing technological solutions, with certification according to international standards. In addition, the project promotes companies that offer services and production inputs along the supply chains. It also supports producers in seven value chains including cashew nuts, peanuts, vegetables, mangos, rice, soya and sorghum with a focus on strengthening quality agricultural production. (https://www.giz.de/en/aboutgiz/profile.html)

2.6.4 United Nations Development Programme (UNDP)

As the United Nations lead agency on international development, UNDP is working across the 16 regions in Ghana within the framework of the Government-UN Sustainable Development Partnership (UNSDP), which responds to Ghana's development priorities and Sustainable Development Goals (SDGs). UNDP contributes to the achievement of Ghana's Coordinated Programme of Economic and Social Development Policies (2017-2024) and the Ghana Beyond Aid Charter towards Ghana@100 (2057) (UNDP, 2022b). UNDP focuses its development interventions on three main programme areas namely governance and peace building, environment and climate action, and inclusive development. Some programmes being undertaken by UNDP include "Empowering farmers towards sustainable livelihoods and the Regeneration and protection initiative". Through the Global Environment Facility Small Grants Programme (GEF-SGP), UNDP has awarded grants to five organizations with women focused initiatives on acquisition of improved technologies for transforming nature-based raw materials into finished-products that meet local and international standards. Through the GEF-SGP, about 250 persons with disabilities, are making a living with their environmentally friendly vegetable farming. Other people with disabilities have been trained in organic farming by using neem tree as a pesticide and compost, to grow fresh vegetables. Through the programme people have accessed small grant to set up a groundnut factory that produce groundnut paste, oil, and vegetables for major markets in Ghana. Over 1200 farmers including young people are combining fish farming with vegetable and crop cultivation. All these initiatives are creating jobs and improving incomes, nutrition, and environmental sustainability (UNDP, 2022a)

2.6.5 Danish International Development Agency (DANIDA)

DANIDA in Ghana has fostered partnerships between Danish and Ghanaian companies for example, the Danish logistics company Maersk which provides logistics and cold chain solutions to help combat food loss in Ghana. Through DANIDA Bluetown, a Danish company is collaborating with CARE International to use digital solutions to help farmers increase yields and income through better farming practices. The Danish company AAK – the world's largest producer of plant oils is working in northern Ghana employing more than 160,000 Ghanaian women, who are organised into women's groups (DANIDA, 2021). In the area of job creation Denmark is spearheading innovative partnerships like the "Skills Development Fund and the Business Sector Advocacy Challenge Fund (BUSAC Fund)" that have both contributed to accelerate market-driven skills development and conducive framework conditions for agricultural development for job creation and productivity gains for the companies involved (DANIDA, 2017). DANIDA launched the Agricultural Value Chain Facility, which was implemented from 2010 to 2016, under which some 28,000 farmers received technical training in integrated soil facility management and practices and a further 64,000 farmers indirectly via radio programmes. New crop varieties, improved soil management and agricultural practices resulted in significant yield increases from 10 up to 150 per cent. About 1,279 lead farmers and 722 volunteer extension workers received intensive training and 1,470 agro-dealers and small and medium sized enterprises received training. They also provided training for staff in Commercial Banks and Sinapi Aba in rural lending (DANIDA, 2021).

2.6.6 Stichting Nederlandse Vrijwilligers (SNV Netherlands Development Organisation)

SNV in Ghana *is* contributing to economic, institutional, social, and environmental development and poverty reduction. Some of its support in Ghana is the implementation of the HortiFRESH project, through a consortium and aims to reach 15,000 farmers and increase their productivity by 20% as at 2021. The HortiFRESH project focused on the vegetable and the fruit sectors in Ghana. Their objectives include improving productivity in the vegetable sector; facilitating more efficient markets, including linking vegetable producers and other value chain operators with the Dutch private sector; improving the business climate and further professionalizing the value chain for vegetable production and consumption in Africa (SNV Netherlands Development Organisation, 2022).

2.7 The USAID Feed the Future Initiative

The United States of America (USA) Government Feed the Future (FtF) initiative is a baby of the Obama Government of USA with the broad objective of combating global hunger, poverty, and malnutrition (Lawson et al., 2016). The initiative is funded by the US government and the FtF strategy is to help developing countries including Ghana to tackle hunger and poverty by addressing their root causes. This is to be achieved through the transformation of agricultural production and improvement in health and nutrition (Zereyesus et al., 2014). The overall goal of the FtF initiative is to sustainably reduce global hunger and poverty. There are two objectives outlined to address the overall goal namely, promotion of inclusive agricultural sector growth and enhanced nutritional status, especially among women and children (Lawson et. al., 2016).

2.7.1 Background to the United States Agency for International Development (USAID) FtF Projects

USAID was created to spearhead the administration of aid to foreign countries for the promotion of social and economic development which was previously undertaken by organisations such as Mutual Security Agency, Foreign Operations Administration, and International Cooperation Administration. Until USAID was established, US policy focused on programmes that supported technical assistance and capital projects and therefore the period between 1952 and 1961 was named the “decade of development” because US development assistance opportunities grew enormously within that period.

Over the years since its establishment, USAID’s focus has gone through several transformations from technical and capital assistance to basic human needs approach through the establishment of currencies and financial systems, to sustainable development, then to rebuilding civil society and basic services such as health care and education and governments infrastructure (USAID, 2021). Currently USAID works in more than 100 countries, with the aim of ensuring economic growth and strengthen democratic governance for stability. This is done through partnership with various institutions and agencies across the US and abroad. Over the years these efforts have yielded results in the reduction of poverty in these countries (Smith, 2017).

The USAID FtF initiative was launched by the United States government in 2009 after the G8 leaders in a summit in L'Aquila Italy, committed to make food insecurity a priority and commit resources to alleviate the problem. This decision was arrived at on the back of the problem of food insecurity caused by the global food price hike between 2007 and 2008. This was at a time when the price of key commodities such as rice, maize and other cereals increased by about 20-30% (Wodon et al., 2008). This formed the basis of the US government FtF initiative which was the US government's contribution to curb poverty, hunger, and malnutrition globally (Lawson et al., 2016). The FtF initiative was launched in 2010 to promote food security and agricultural development activities in selected developing countries (Lawson et al., 2016).

According to Smith (2017) FtF is currently working to support food security and nutrition strategies and to transform agricultural development in 19 countries. He indicated further that through USAID, extreme poverty has reduced from 6 to 40 percent and more than 10 million smallholder farmers have acquired skills in the application of new technologies and management practices. Smith further indicated that USAID leadership on food security has also placed agriculture, the main source of income and employment for the 70% of the world's poor living in rural areas back to the global agenda. In Kenya for example, USAID efforts has helped in reducing the depth of poverty, and similarly in Ethiopia, USAID investment in community resilience and early response during the 2015-2016 El Nino drought helped millions of Ethiopians to cope (Smith, 2017).

USAID assistance in Ghana involves the implementation of programmes for increased productivity in the agricultural sector for job opportunities and improved incomes for the poor as well as programmes to improve the quality of health services and education; and strengthen local government institutions (USAID, 2016). In the past, before the FtF initiative USAID had been promoting economic growth in Ghana through programmes such as USAID Trade and Investment Program (TIP), USAID Trade and Investment Reform Program (TIRP) and Trade and Investment Program for a Competitive Export Economy (TIPCEE) that supported non-traditional exports as well as horticultural exports (Easterling et al., 2008).

2.7.2 The Feed the Future Initiative in Ghana

The Ghanaian economy is dependent to a large extent on agriculture and the sector has determined and is likely to continue to determine the success of any development strategy of the country. Ghana is a focus country under the FtF initiative. Under the FtF initiative USAID's Economic Growth Program focuses on boosting the productivity of some selected crops such as maize, rice and soya beans in northern Ghana considered the region with the most vulnerable and the poorest in Ghana (USAID, 2016). The focus is in line with the Government of Ghana's development policies outlined in earlier parts of this section, and comes to boost effort to achieve poverty reduction in northern Ghana.

The overall goal of FtF in Ghana is to reduce the prevalence of poverty and stunting in northern Ghana by 20%. In this regard several projects including capacity building projects (Appendix 4) have either been implemented or are being implemented in northern Ghana to strengthen the maize, rice, and soybean value chains, introduce improved and climate-smart production methods; and to build the capacity of smallholder farmers, and other key stakeholders (USAID, 2016). The capacity-building projects are targeted at rural northern Ghana because that is where the majority of the poor smallholder farmers are concentrated. Some of the FtF projects have been completed and therefore it is important to investigate whether they have achieved their objectives or otherwise.

This section of the literature review helped with the identification of policies, projects and programmes implemented in Ghana in the past which were directed at poverty reduction, highlighting their successes and failures. This helped with the write up for the study background and preliminary discussions for the development of the problem statement. This section of the literature review also helped with the identification of the FtF Project implemented in Ghana and the capacity-building projects selected for the study.

2.8 Farmer participation in Agricultural Project Interventions

The 1950s and 60s marked the first development decades in which community development became the norm and was used to raise the standards of living of people in the third world. This was part of the independence and decolonization of Africa (Peprah, 2017). However, in a developing country like Ghana, it is argued that the decades of development aid, strategies and efforts have not succeeded in improving the standard of living of most of the population (Koehler, 2015). Efforts by different governments, the International Monetary Fund (IMF) and the World Bank in the programmes, policies and strategies that were designed to reduce the poor living standards of the people and create the environment for sustained economic growth and prosperity was not achieved. This has largely been blamed on the approaches such as the top-down approach used in agricultural interventions implemented to reduce poverty. With the top-down approach interventions are implementation from the perspective of decision makers without recourse to the beneficiaries and in the process neglect key actors especially farmers (Issa et al., 2011; Etwire et al., 2013). That has been the main flaw of this approach.

Presently, within the development circles the top-down approach in engaging beneficiaries of programmes is known to be unsustainable and unable to empower target beneficiaries. The bottom-up approach which has emerged as a better alternative is said to be more expensive and is likely to raise problems of financial sustainability (Directorate of Agricultural Extension Services of Ghana, 2021). However, the bottom-up approach considers the beneficiaries as partners, utilizes local experience, and endeavour to empower target beneficiaries (Kumba, 2003 as cited in Etwire et al., 2013). Currently, in Ghana the bottom-up approach has arguably been adopted by most agricultural projects with an emphasis on collaborations and coaching farmers to solve their farming challenges (Etwire et al., 2013). The bottom-up approach encourages local participation of stakeholders including farmers. It means farmer participation is key if any agricultural intervention is to succeed.

The stream of development thinking points to participation as “a process of empowering those who were previously excluded from achieving power; that is, power in terms of access to, and control of the resources necessary to protect livelihood” (Oakley & Marsden, 1984, as cited in Gyenfi, 2014). The Human Development Report UNDP (1993) emphasizes the participation of people in their own development, since people's participation is becoming the central issue in the face of current challenges for development.

It is important to clearly define participation in the context of agricultural intervention. Most authors have defined participation in various ways (Tandon, 2008; Farid et al., 2009; Yaro, 2013). Participation refers to the way people involve themselves as individuals or as groups in development processes to ensure self-reliance and improved living standards (Nxumalo & Oladele, 2013). Yaro (2013) indicate that for any meaningful development to occur, it requires the local population to define, motivate and control processes. This involves participation and empowerment. In this study participation will be farmers involvement in the initial activities of the project interventions and the active involvement in the various processes expected to empower them with knowledge to be able to improve on their decision making and farm performance. Empowerment involves helping to develop the skills and capacities of local people to be able to take charge of their own situations by being able to identify the potentials in terms of resources and avoid their weaknesses to achieve the best within their environment (Gyenfi, 2014).

Farmers play critical role in the outcomes of agricultural projects. However, a farmer's decision to participate in an agricultural project is influenced by various factors. Factors such as farm location, sex, age, access to credit, contact with agricultural extension, and farm size may have positive or negative effect on farmers' participation in agricultural projects (Etwire et al., 2013). A study by Nxumalo and Oladele (2013) show a positive relationship between the age of a farmer and participation in agricultural projects. Meanwhile Oladejo and Olawuyi (2011) found a negative relationship between marriage and farmers participation in agricultural projects. According to Nnadi and Akwiwu (2008) it is more likely for the educated to participate in agricultural projects and utilize the knowledge acquired. Farid et al. (2009) however observed a negative relationship between education and women's participation in agricultural activities. Oladejo and Olawuyi (2011) and Nxumalo and Oladele (2013) did not observe any significant relationship between education and the decision to participate in an agricultural project.

In a study to evaluate the effectiveness of good agronomic practices Quarmine (2013) compared farmers who took part in participatory research with farmers who learned GAPS through the conventional linear extension methods. He concluded that groups that participated actively in learning activities had improved knowledge. The study concluded that farmers' involvement in development and experimentation helps in improving their knowledge about innovations than when they are just passive end-users. This was in agreement with studies that suggested that participatory methods of innovation development result in significant improvement of farmers' knowledge (Ogbonna, 2019; Yost, 2017; Leitgeb et al., 2011).

In a study to identify factors that mitigate against farmers participation in agricultural projects, Etwire et al. (2013) found out that the factors that significantly determine farmers' participation in agricultural projects in the Saboba and Chereponi districts of northern

Ghana include agricultural extension service, access to production credit, and the number of years in school. They suggested that agricultural projects must target full time farmers for optimum impact.

They further suggested that it may even be desirable not to select very educated people as lead or contact farmers. Etwire et al. (2013) proposed that agricultural projects should also endeavour to provide FBOs or farmers with credit preferably input credit or revolving input credit as starter packs. Also, agricultural projects should provide extension services to FBOs participating in their projects. Such extension services could be in the form of technical training and on-farm demonstrations.

2.8.1 Measuring farmer participation in agricultural project interventions

Several studies have been undertaken to assess farmer participation in agricultural projects (Issa et al., 2011; Etwire et al., 2013; Jamilu et al., 2015; Osabohien et al., 2020). A study by Etwire et al. (2013) to assess the factors that influence farmers' participation in agricultural projects used the binary probit model to estimate the determinants of farmer's participation in agricultural projects. The results of the analysis indicate that number of years in school, access to production credit and agricultural extension service are factors that significantly determine farmer's participation in agricultural projects. In an earlier study Samah (1992) organized the assessment of participation into five phases namely, participation in decision making, participation in implementation, participation in benefits, and participation in evaluation, and intensity of farmers' participation. In this study a composite score was determined for each attribute of participation but not used to categorise the levels of participation. In a similar study Jamilu et al. (2015) used descriptive statistics and logit regression analysis to assess factors influencing smallholder farmers' participation in agricultural projects. The result showed that household size, farm size, level of education, membership of cooperative and extension contact influenced participation in the project. Omotesho et al. (2016) used a five-point Likert scale to elicit information on the level of participation of farmers in their farmer-group activities. The respondents rated on a scale of 1 to 5, the extent to which they agreed or disagreed with the statements posed to them on their participation in group activities. The results revealed a positive relationship between the respondents' farm sizes and their levels of participation in group activities at 5 percent level of significance.

In the current study based on questions (pertaining to participation in project meetings, field demonstration and group activities) that were posed to the farmers, in a participatory nature, the farmers were allowed to rate their participation as low, partial, and high. The rating was based on their participation in project implementation meetings, field demonstration activities and group activities.

This section of the literature review helped with the approach adopted by this study in measuring farmers participation in agricultural project interventions.

2.9 Farmer Innovative Performance

Innovation is an important engine for growth in a sector. The agricultural sector faces myriad of challenges and there is the need to find solutions to sustain the sector and its relevance. Meeting the challenges require constant innovation. This implies that growth in the agricultural sector depends on innovation (Zizlavsky, 2016). Systemic innovation has been characteristic of successful enterprises that are also said to be competitive. This competitive success comes from doing things differently and reinventing themselves through innovative capacity (Fiorentino, 2010, as cited in Zizlasky, 2016). According to Zizlavsky (2016: 819) innovative performance can be understood as "the ability to transform innovation inputs into outputs, and thus the ability to transform innovation capacity and effort into market implementation". In a study of knowledge-processing capabilities and innovative performance, Jantunen (2005) indicated that although knowledge may be important, it is not the stock of knowledge that a firm possess that matters but the utilization of that knowledge that is of optimum importance for maintaining innovative performance. However, Jiang & Li (2009) opined that the processes of creation, transfer, and sharing of knowledge are central to the success of innovations that emerge.

The knowledge management and organisational learning literature suggest that a firm's ability to acquire, learn, utilise, and diffuse knowledge within and across organisational boundaries, in turn, provides competitive advantage and produces improved performance of the firm (Jiang & Li, 2009). However, Jiang and Li (2009) posit that knowledge management does not always have a direct impact on business and economic performance, instead it may have a more direct impact on the firms' innovativeness, and IP. The ability of the firm to acquire and utilise knowledge effectively is argued to be critical for the firm's innovation activities and performance (Ode & Ayavoo, 2020 ; Castaneda & Cuellar, 2020). In the same vein, within the farm setting where FBOs are trained, information sharing and utilisation within farmer networks may be of essence in building social capital in communities and IP enhancement. Social capital fosters trust among people to enhance knowledge exchange, decision making, and social action (Schuller & Theisens, 2010).

Jokisaari and Vouri (2014) studied the joint effect of social networks and information giving on innovative performance. The argument within the social network approach is that a focal person's performance on the job is enhanced by his or her social networks which is due to information gained through the networks (Burt et al., 2013). Others for example Burt (2004) state that sparse networks assumingly enable access to heterogeneous information and ideas, and this enhances IP. According to Aral and Alstyne (2011) within the network space strong ties between individuals help them to acquire knowledge that enhances their IP. Therefore high quality human capital is very crucial in ensuring innovative performance (Li et al., 2019). Within the social network approach, the argument is that the ways in which a person gets information and advice, resulting in innovative performance, is also dependent on the characteristics of the social networks (Burt, 2005, as cited in Jokisaari & Vouri, 2014). Therefore, the way networks are facilitated has a direct bearing on innovative performance (Lambrecht et al., 2015).

In a study about learning about a technology Conley et al. (2000) indicated that in order for a technology to be adopted by an agent, particularly in agriculture, it must be adopted to the circumstances faced by that agent. They further state that in situations where there are multiple users of the technology in similar circumstances then the processes of learning about the new technology may be social. New users of the technology would have to learn from each other. A major expectation of the study is that in line with literature, farmers with improved knowledge will try out their newly acquired information on their farms and share the information, hence improve their productivity. The effectiveness of farmers' participation in research processes with respect to improving their knowledge about GAPS and the likelihood that farmers will practice and share what they have been taught in diverse ways was evaluated. Therefore, farmers' utilisation and sharing of knowledge is referred to as "farmer innovative performance" in this study.

Knowledge transfer is regarded as a precondition of innovation processes because it creates partnerships and builds capacity (ENRD, 2013, cited in Bonfiglio et al., 2017). Etriya et al. (2019) suggested that heterogenous networks enhance farmers' performance through the provision of information, advice, and other resources. They suggested that different types of indicators could be combined as a construct of innovative performance to indicate farm performance.

2.9.1 Farmer Innovative Performance and Agricultural Productivity improvement

Capacity building is expected to provide smallholder farmers with the requisite knowledge and skills that will enable them to improve their productivity. At the same time smallholder farmers are expected to innovate with the knowledge they have acquired to improve their incomes, food security and well-being. Meanwhile, innovation is seen as one of the main drivers of productivity in the agricultural sector (OECD, 2013).

Innovation has been recognized as a very important component in any effort to improve agricultural productivity when it comes to the agricultural sector especially in developing economies. According to Läpple et al. (2016), innovation not only refers to technology development but also changes in thinking and behaviour. Tesfaye et al. (2010) posit that any farmers' training is intended to bring about desirable changes in their knowledge and attitude to enhance job performance. According to Perry-Smith and Shalley (2003) innovative performance often consists of "combining knowledge from different domains, that is domain knowledge". Odonkor (2004) explained that farmers' innovative performance entails changes expected to have occurred in farmers' knowledge, attitude, practices, and skills and the socioeconomic effect of these changes on their productivity and management within their communities. Indeed, to innovate, stakeholders need to experiment with the knowledge learned in a domain to see how it could be of use in another (Hargadon, 2002). It implies that when actors in a system, for example, farmers gain knowledge, they should be able to apply the knowledge in ways that enhance their performance on the farm and improve productivity. Crop yields are directly linked and used as a measure of productivity (Nordj & Adjasi, 2020) and therefore innovations introduced through capacity building activities, to improve crop yields is key to productivity improvement that leads to improving farmers' income, food security and well-being (Danso-Abbeam et. al., 2018). In this study crop productivity was measured as yield per hectare.

In a study to assess training effectiveness Tesfaye et al. (2010) showed that training conducted for farmers improved their knowledge, attitude, and practices when compared to that of untrained farmers. A study by Läpple et al. (2015) indicated that farmers with high innovative performance have higher farm incomes, invest more, have larger farms and are also younger than less innovative farmers. In a study to investigate the impact of innovation on economic sustainability Läpple and Thorne (2019) found out that given a certain level of innovation, a relatively small level of improvements to innovation can lead to significant economic gains. They also found out that innovative farmers can achieve further economic gains by innovating further.

2.9.2 Measuring innovative performance (IP)

Innovative performance has been studied extensively on companies to determine their performance in a changing world driven by innovativeness (Cabello-Medina et al., 2011; Liu et al., 2015; Lappel et al., 2015) However, there are not yet any generally accepted common set of indicators that measure it (Hagedoorn & Cloodt, 2003). In their study of IPs of nearly 1200 companies, Hagedoorn and Cloodt (2003) used indicators such as R&D inputs, patent counts and patent citations and new product announcement as measures for a latent variable, IP. Their findings suggested the use of the four selected indicators could be used to measure the IP of companies in high tech industries. Hagedoorn and Cloodt (2003) argued that there are no clear understanding of IP and proposed the use of multiple indicators to measure IP instead of a single indicator. They further explained that a composite measure can be analysed in detail, in terms of the individual indicators and with reference to the contribution of each indicator to the latent "innovative performance".

According to Etriya et al. (2019) the development of innovations for firms requires experimentation. These experiments are farmers own research activities that generate information. The information then contributes to the innovations (Leitgeb et al., 2011). Experiments by farmers involve evaluation of technologies introduced to them before final usage. In their study Etriya et al. (2019) used the size of the plots used by the farmers for experimentation to represent innovative performance. They were however of the opinion that there could be other indicators, such as new products (Hagedoorn & Cloodt, 2003) or new improvements, that may limit the understanding of innovative performance. They therefore emphasized the need to combine different indicators as a construct for innovative performance.

Jokisaari and Vuori (2014) used a four-item measure to evaluate new employees' innovative performance, that is “creativity and innovation in one's job and the organization as a whole” (e.g., “coming up with new ideas”; “creating better processes and routines”; 1 = “needs much improvement”, 5 = “excellent”). The responses to the four items were averaged to create the innovative performance measure.

Chindime et al. (2017) in a study of determinants of innovation performance computed innovation indices to measure the innovation performance. They used four indicators namely, breeding, feeding, animal health, and market, to construct innovation performance. They computed an innovation index that showed the levels of innovation among the farmers and used a regression model to isolate the determinants of innovation. The results showed that knowledge was significant and had a positive effect on the innovation index.

In order to measure innovation in agricultural firms three main tools have being proposed namely; the Innovation Matrix (IM), Innovation Index (II), and the OLS estimation procedures (Ariza et al., 2016). In a study to measure and understand agricultural innovations Lappel et al. (2015) developed a framework that accounted for the complexity of innovation by combining indicators to measure agricultural innovation based on farm level data. They used indicators such as knowledge acquisition, innovation adoption, and continuous innovation to generate a composite index rather than a single indicator.

In a study to determine what drives innovation in the agricultural sector Lappel et al. (2016) used the innovation index approach developed by Lappel et al. (2015). In relation to innovation adoption, five technologies and farm practices were selected for each of the main farm systems which operate in Ireland, four of which are common to all systems. Once calculated, the three individual indicators were then given weights to reflect their relative importance for innovation. Once the individual innovation components are weighted and summed, the final agricultural innovation index takes values between zero and one, with larger values indicating greater levels of innovation.

The literature review helped in the measurement of innovative performance and further enabled the identification of indicators for the construct of innovative performance in this study. Farmer's knowledge, whether practicing the technologies and practices introduced to them, contributions to discussions, sharing information with others, contributing to local platforms, experimenting, attracting resources to the community, and making resources available to aid the community were used in the construct of innovative performance. PCA was used to generate scores for the IP of each farmer which was categorized as low, medium, and high.

2.9.3 Capacity building and poverty reduction

Human capital is critical and has a role to play in the acceleration of agricultural productivity through learning, application, and the dissemination of technical knowledge. That way, a farmer's capability to adjust new technology in particular circumstances as changes may demand is greatly enhanced (Mozumdar, 2012).

Capacity-building dates back to the 1950s and 1960s and has evolved over several decades (Merino & Carmenado, 2012). In the 1950s the focus of capacity building was on improving the institutional infrastructure of developing countries and improving the ability of development organisations to implement donor-funded projects. From the 1960s to the 1970s the focus shifted to training and technical assistance. During the 1980s and the 1990s counselling networking and market access became the main focus. Then in the 2000s, the focus shifted once again to deepening guidelines and best practices (Rutger, 2007).

The definition of capacity building has bothered on improvement in individuals, organisations, and institutions. The OECD (2006: 14) defined Capacity Building as: "the process whereby people, organizations, and society as a whole unleash, strengthen, create, adapt and maintain capacity over time". The European Commission (2005:5) defined Capacity Building as "the process by which people and organizations create and strengthen their capacity over time". The UNDP (1997: 3) defines capacity building as: "the process by which individuals, organizations, institutions, and societies develop abilities (individually and collectively) to perform functions, solve problems and set and achieve objectives." Gordon and Chadwick (2007: 18) defined capacity building as "encompassing training and all other forms of learning that enhance the knowledge, understanding, and competences (skills) of individuals". Guided by the study's focus of assessing the influence of capacity building on the individual smallholder farmer, Gordon and Chadwick (2007) definition will be adopted by this study.

In an impact assessment of capacity building and training, Gordon and Chadwick (2007) indicated that "the benefits of capacity building could be tracked through three main pathways from human capital development to the economic benefits of capacity building. The first is improved productivity of the individual undertaking the training and the information flow of the training to other individuals. The second is capital productivity arising from complementarity between human capital and physical capital as more capable workers can better adapt to and utilize equipment and machinery and the latest technology. The third is total factor productivity arising from better management, intra and inter-firm synergies and, over time, higher rates of innovation and improvement in the enabling environment" (Gordon & Chadwick, 2007:18).

In the development process building up a stock of human capital as in-stock of knowledge and that of physical capital is important. The concept of human capital encapsulates investment in human capital that may result in the development of the individual (farmer) as an economic factor (Shingarov, 2012). In this case, farmers must be well placed to be able to take advantage of improved technologies to help in productivity improvement. A review of the various agricultural policies shows the desire by various governments to develop the country's human capacity especially the agricultural human resource base (farmers) who must keep up with the introduction of new technologies to improve productivity. Therefore, the need for human capacity development within the agricultural sector cannot be overemphasised.

According to Gordon and Chadwick (2007) labour productivity results in more revenue, contribution to the stock of knowledge, transfer of knowledge, skills, and attitudes to others (workers), and other sources of human capital. They explained that when an individual's capacity is improved it adds to their well-being. Therefore, participation in training enhances the social well-being of individuals such as health, child quality, lower fertility rates, more efficient consumer choices and lower crime rates. Suffice to say that the capacity-building projects being undertaken under the FtF initiative is relevant for productivity improvement in the agricultural sector of Ghana.

The relevance of agricultural capacity building has been discussed in this section and will help with the discussion of the findings and the recommendation for this study.

2.9.4 Agricultural Productivity and Poverty Reduction

Agricultural transformation largely depends on productivity. Higher productivity enables farmers not only to have enough food to feed their households, but also to acquire income from the sale of the surpluses to meet their non-food needs. As productivity increases, smallholder farmers accumulate more assets and engage in non-farm productive activities, increasing household income, which in turn, enhances their general well-being. Higher productivity will also generate surpluses to be used by the agro-processing industries as raw materials (African Center for Economic Transformation (ACET), 2017).

According to Tran et al. (2016) agricultural productivity is a key driver for the wellbeing of farmers and is also linked to food security and poverty alleviation in developing countries. Agricultural productivity is an important means in achieving poverty reduction and food security through innovative technologies within the agricultural sector (Al-Hassan & Diao, 2007). Therefore, research into agricultural productivity is paramount especially where capacity has been built in an attempt to reduce poverty.

Improving low agricultural productivity coupled with improved access to inputs and markets was the antidote to poverty in family farms in developed countries. This was because farmers obtained more profit from producing more and that enabled them to invest in technologies (Becx et al., 2012). It also means that with improved productivity smallholder farmers could allocate the scarce resources for example, using inputs more efficiently (FAO, 2017b) that may lead to higher yields, incomes, food security and well-being and in effect achieve poverty reduction.

Productivity is commonly defined as “a ratio of a volume measure of output to a volume measure of input use” (OECD, 2001:11). In its simplest form, productivity measure describes the relationship between the production of a commodity-goods or services and inputs used to produce that commodity (FAO, 2017b). Fuglie (2018) posit that raising the productivity of agricultural labour boosts incomes of farmers and therefore agricultural productivity could be achieved by reducing the amount of labour, land, and other resources needed to produce food. He further indicated that higher agricultural productivity makes food cheaper and more plentiful and has a powerful effect on poverty.

2.9.5 Productivity Measurement

According to Sekyi et al. (2017) the literature differentiates two productivity measurements in agriculture: partial and total measures. Partial measurement considers the amount of output per unit of a particular input. The most widely used partial measures are yield (output per unit land) and labour productivity (output per economically active labour or per agricultural person-hour). They argue that the use of partial measures could be misleading as there is no clear-cut indicator on why they change. They gave the example that, land and labour productivity may increase because of increased use of tractor, fertilizer, output, mix, among others. To account for at least some of these difficulties a total productivity measure known as total factor productivity (TFP) was developed. The TFP is the ratio of an index of agricultural output to an index of agricultural inputs (Fuglie, 2004). In the absence of information that will warrant the use of TFP, Sekyi et al. (2017) used output per hectare as a measure of agricultural productivity. Abdallah (2016) and Nkegbe (2018) used technical efficiency as a measure of productivity. Nordjo and Adjasi (2020) used direct productivity-yield of maize measured in metric tons per hectare, instead of technical efficiency. According to the US Department of Agriculture (USDA), yields per crop acre is a measure of productivity (Miljkovic et al., 2008).

Varied empirical studies on the determinants of productivity have focused on farm size or land holdings. Mazumdar (1965) as cited in Sekyi et al. (2017) observed that increasing farm size decreases productivity and this view is supported by Larson et al. (2014) who found an inverse relationship between farm size and productivity.

Studies by Kimhi (2003) and Larson et al. (2014), focused on variables such as farm size, labour availability, cost of production inputs, soil conservation quality as determinants of productivity. Other studies by authors such as Sekyi et al. (2017) and Nordjo and Adjasi (2020) also focused on the impact of credit on productivity. Studies by Ayaz & Hussain (2011) and Abel et al. (2015) have also shown that access to credit has a positive and significant impact on productivity.

Since crop yields are linked to agricultural productivity there is therefore the need to increase agricultural yields to address issues bordering food insecurity, improved diets and increased incomes. Low incomes have been identified as the major cause of food insecurity (Gundersen et al., 2011). This is because household access to food can either be through direct production or purchases from the markets. Therefore, when household capacities that depend on agriculture for food or livelihood are developed it is perceived that poverty reduction and food insecurity will be addressed simultaneously (Cadger et al., 2016). In a study to assess the effect of crop productivity on poverty among farm households in Ghana, Boahen et al. (2020) indicated that a 1% increase in crop productivity results in 0.38% and 0.75% reduction in poverty gap and poverty severity respectively. For the purposes of this study crop yield (output) in kilograms per ha was used as productivity.

This section of the literature review helped in the identification of the measure to use for productivity and that is yield in kilograms per hectare.

2.10 Poverty Reduction

Poverty is recognised as a worldwide phenomenon and therefore many development programmes and projects focus on how to reduce it. In the economic sense poverty can be described as circumstances when people are unable to attain a minimum living standard (Edig, 2005). Edig further indicates that the level of welfare or well-being at which one can be said to be poor is one important criterion used in the assessment of poverty, and household income or household consumption is one approach used in measuring well-being. According to Edig (2005), poverty can be differentiated into absolute and relative poverty. While absolute poverty is concerned with minimum living standard of a person, relative poverty is concerned with the situation of an individual or group of persons in relation to average living standard of the society they live. With relative poverty the focus is on economic inequality within the population.

Cahyat and Haug (2007) defined poverty as “a situation in which an individual or a household has difficulty fulfilling its basic needs, lacks opportunities provided by an enabling environment to sustainably improve its well-being or is vulnerable to losing its current standard of living”. They identified three (3) levels of conditions within this definition of poverty namely, subjective well-being, core well-being and enabling environments. Subjective well-being refers to the feelings of prosperity, happiness, being respected, being acknowledged, being poor, or similar feelings mainly influenced by all aspects of life. Core well-being has to do with basic material and non-material needs including nutrition and health, knowledge, and material wealth. The issue being respondents having had basic needs fulfilled in the last 12 months. Enabling environment involves the living environment that affects the core well-being issues which can be natural, economic, social, and political which enable households to constantly improve their quality of life and at the same time reduce vulnerability. For the purposes of this study Cahyat and Haug (2007) definition of poverty will be used.

The world over people who are poor live mostly in rural areas and mostly found in the developing countries. In Ghana most of the poor are found in the northern part of the country and depend on agriculture for a living. One important feature of the Ghanaian economy is the disproportionate concentration of poverty in northern Ghana which has been discussed earlier in the problem statement. For these reasons several agricultural interventions have been implemented in that part of the country. The most recent interventions being the USAID FtF initiative projects which seek to reduce poverty in northern Ghana.

Emphasis has been placed on the fact that agricultural projects are key in poverty reduction strategies of developing countries and Ghana is no exception. Most poverty reduction strategies implemented over the years have been in the form of one agricultural project/programme or the other. Through these projects Ghana has achieved an overall reduction in the poverty rate from 52 percent to 28 percent by 2015 making agricultural growth the major driver of poverty reduction in Ghana (www.feedthefuture.gov). Various projects that have been implemented over the years to address poverty in Ghana have been discussed in earlier sections. For projects implemented under the FTF initiative with the aim of reducing poverty in northern Ghana, refer to appendix 4.

This section of the literature review helped in understanding the concept of poverty and the identification of relevant indicators that were used in the measurement of poverty reduction in this study. These include improved incomes, food security and well-being.

2.10.1 Components of poverty reduction: income, food security and well-being

Several studies have used yield as a measure of agricultural productivity (Miljkovic et al., 2008; Sekyi et al., 2017; Nordjo & Adjasi; 2020). Meanwhile, agricultural productivity has been linked to poverty reduction because it contributes to income growth and poverty reduction through income generation, provision of food and employment in developing countries (Dethier & Effenberger, 2012). This makes agriculture the main source of livelihood for households in rural areas and therefore an effective tool for poverty reduction.

Higher agricultural productivity ensures enough food to feed households and more income to meet non-food needs. As productivity increases, smallholder farmers accumulate more assets and engage in non-farm productive activities, increasing household income, which in turn, enhance their general well-being (ACET, 2017). As suggested by Edig (2005) well-being is one of the key measurements of poverty and that the level of welfare or well-being at which one can be said to be poor is one important criterion used in the assessment of poverty. Edig further indicates that household income or household consumption is one approach used in measuring well-being.

As suggested by Gundersen et al. (2011) one major cause of food insecurity is low incomes because of its link to household food access either through direct production or purchases from the markets. A study by Boahen et al. (2020) indicate that increased crop productivity results in the reduction in poverty gap and poverty severity. It therefore means that improved productivity may lead to higher yields, improved incomes, food security and well-being and in effect achieve poverty reduction as was the case in poverty reduction in family farms in developed countries (Lipton, 2005; Becx et al., 2012). FAO (2017b) linked improved productivity of smallholder farmers to high yields, incomes, food security and well-being as a means to address poverty. In this study the key components used to access poverty reduction in northern Ghana are income, food security and well-being of farmers.

2.10.2 Improved Income as component of poverty reduction

Persistent poverty in northern Ghana has been attributed to several factors (section 1.3) including inadequate knowledge of farmers in modern agricultural production practices. The fact that farmers cannot produce enough food to meet their consumption needs and also be able to sell for income that may be needed to buy food for the household deprives them of basic needs. This may result in their inability to pay their children's school fees, pay hospital bills among other things keeping them in the poverty cycle. Poverty can be directly linked with low productivity which results in low yields and low incomes for farmers.

One way of bringing smallholder farmers out of this poverty cycle is to build their capacity to add to their stock of knowledge and skills. This coupled with other interventions may help improve productivity in agriculture which most often is their main livelihoods (Gordon & Chadwick, 2007). With improved capacities farmers become economic factors or agents that will take advantage of improved technologies to improve productivity (Shingarou, 2012). According to Gordon and Chadwick (2007) more revenue could be achieved through labour productivity.

Fuglie (2018) suggests that a boost in farmers' income is linked to improvement in productivity. He further stated that with improved productivity food becomes cheaper, plentiful and impacts poverty. This implies that with just a little more income households can be assured of food. According to Gundersen et al. (2011) low incomes cause food insecurity because households access food either through direct production or purchases from the markets.

According to Norsida and Sami (2009) income strengthens farmers well-being. Previous research by Cotterell et al. (2008) indicate that income impinges well-being. Therefore, income is an important indicator of farmers' welfare. Improved productivity through the adoption of improved technologies is a means to increase income, food security and household welfare (Islam, 2018).

In a study to assess the effect of the Association of Church-Based Development NGOs

(ACDEP) agricultural extension services on-farm productivity and income of smallholder farmers Danso-Abbeam et al. (2018) indicated that there is a positive effect of the programme on productivity and farm income of households. They also found out that participation in the programme improved the farmers welfare through an increase in famers income. Obviously, the spread of new technologies helps in reducing poverty directly by raising farmers income and directly lowering the price of staple food (De Janvry & Sadoulet, 2002). Similarly, Wu et al. (2010) in a study to access the impact of improved upland rice technology on farmers well-being found that the technology had robust and positive effect on farmers well-being through increase in income and decreases in poverty. They however observed that the effect of technology on well-being showed a diminishing impact over time and therefore not sustainable. They therefore, recommended that agricultural technology innovations need to be generated and promoted continuously to replace older ones. Bertin et al. (2014) suggest that farmers who participate in training programmes achieve higher incomes through improving their innovative capacities and management practices. Similarly, a study conducted in eastern Ethiopia which investigated the impact of improved agricultural technology use on farm household income, showed a statistically significant increase in household farm income as a result of using improved agricultural technologies (Wordofa et al., 2021).

2.10.2.1 Measurement of income

Two types of income were identified during the literature review. These are total household income and crop income. Danso-Abbeam et al. (2018) differentiates between the two types of incomes as follows: total household income is treated as the summation of the revenues from all the crops of the household, revenues from the sale of livestock and income from the non-farm economic activities such as wages, salaries and other self-employed businesses earned by the members of the household while crop income is the total earning from the sale of crop output.

This section of the literature review helped in the choice of methods used in measuring income. In this study income is treated as the total earning from the sale of each selected crop (maize, rice, and soybeans).

2.10.3 Food Security as component of poverty reduction

Food security exists when all people, at all times, have physical, social and economic access to sufficient safe and nutritious food that meets their dietary needs and food preferences for an active and healthy life (World Food Summit, 1996). According to (Simon, 2012) the word social was added to the 1996 definition of food security in 2002.

FAO (2014) reported that there are four dimensions of food security: availability, access, stability, and utilization. FOA defined the four pillars of food security which are availability (adequate quantities of food), access (sufficient resources to gain access to adequate food), utilisation (capacity to utilize and absorb nutrients in consumed food) and stability (adequate food is consistently available and accessible) (Odulara, 2015). According to FAO one of the key determining factors of food security is the availability of food and its constituents. Food might be available but might not be varied enough to provide the essential nutrients for a healthy life. Access to food is basically determined by income, ability of households and individuals to access social support, and prices of food. Physical access to food is also import in determining food access. Stability introduces a time dimension, albeit short term, to food security. Food security may also be considered circular, as there is a feedback loop from utilization to availability since human capital depends on optimal nutritional state for the workforce in agriculture and in all sectors of production (Berry et al., 2015).

Simon (2012) indicated that there are some elements in the World Food Summit definition of food security which were not included in the four dimensions and that is "food preferences for an active and healthy life" which he proposed could be subject for further research. Peng and Berry (2018) suggested a fifth pillar of food security which is sustainability to be added to the existing four. This was later supported by Guiné et al. (2021) who also indicated that the food security concept is part of sustainability hence the need to add it to the existing pillars.

According to Wight et al. (2014) there is a strong link between food insecurity and poverty. This link arises from the fact that there is the need to access food physically and economically and the large dependence of livelihoods, incomes, and economic growth on agriculture. This makes agriculture an important development locus for poverty reduction. To access food households can either engage in direct production or purchase from food markets. This gives credence to increasing the production capacities of households and communities that depend on agriculture for food and livelihoods to reduce poverty and food insecurity simultaneously (Cadger et al., 2016).

Food sovereignty and Nutritional security

Food sovereignty has emerged as a critic of the foreign domination of the states by the international trade rules of the World Trade organisation (WTO) as well as the neo liberalised credit conditions imposed by the world Bank and the International monitory fund (IMF) http://www.globalagriculture.org/report-topics/food-sovereignty.html. In response to this new, trade-driven notions of food security, La Via Campesina, an activist group, comprising a network of NGOs and an international social movement was created also in response to the inclusion of agriculture within the world trading system through the Agreement on Agriculture (AoA) (Odularu, 2015). AOA is a treaty negotiated during the Uruguay Round of the General Agreement on Tariffs and Trade and became the World Trade Organisation in 1995.

La Via Campesina promotes food sovereignty rather than food security and call for the exclusion of agriculture from the international trade system and at the same time reject agricultural biotechnology and industrial agriculture in favour of localised food production and the protection of rural livelihoods across all nation-states (Polzin, 2018). La Via Campesina first defined food sovereignty as “the right of each nation to maintain and develop its own capacity to produce its basic foods respecting cultural and productive diversity”. This definition was further classified and elaborated upon through the Nyéléni Forum for Sovereignty, held in Mali in 2007. A new definition of Food Sovereignty ensued in the Nyéléni Declaration as “the right of people to define their own food and agriculture policies, to protect and regulate domestic agricultural production and trade so as to attain their objectives of sustainable development, to determine in what measure they want to be autonomous and to limit the dumping of products on their markets"[2].

Through the efforts of various NGOs and social movements of which La Via Campesina is inclusive, the International Planning Committee for Food Sovereignty (IPC) has been put in place which serves as focus institution for the food sovereignty movement. IPC suggest that food sovereignty comprises of four pillars namely, right to food, access to productive resources, mainstreaming of agro-ecological production, trade, and local markets[3]

Meanwhile the continued incidence of hunger and malnutrition in Africa challenge African policymakers, researchers, and development practitioners, as reports indicate that majority of the 842 million chronically undernourished in the world live in Africa (Odularu, 2015). Stakeholders in African agriculture opine that significant increases in the level and quality of public and private investments in agriculture and food systems is needed to reduce hunger and malnutrition in a sustainable manner. This notion has been reenforced by the Committee on World Food Security (CFS) (Odularu, 2015).

The concept of nutrition security recognizes the co-existence of food insecurity and diet-related diseases and disparities. That is, nutrition security means having consistent access, availability, and affordability of foods and beverages that promote well-being and prevent

[2] (Via Campesina, the right to produce and access to land, Food Sovereignty: A Future without Hunger [put as foot note]).
[3] (International Planning Committee for Food Sovereignty (2006) IPC Focal Points, URL: http://www.foodsovereignty.org/new/focalpoints.php).

disease among the disadvantaged (racial/ethnic minority populations, lower incomes populations, and rural and remote populations). Nutrition security focuses on complementing efforts to address food security among a people by ensuring access, availability, and affordability of foods and beverages among populations plagued with food insecurity and diet-related chronic diseases (https://www.nifa.usda.gov/topics/food-nutrition-security).

Ghana was able to achieve the MDG of eradicating extreme poverty and hunger through high economic growth with its associated economic transformation through social protection programmes (NDPC & UNDP, 2015). This made Ghana one of the first African countries to achieve the MDG of halving both extreme poverty and hunger. However, food insecurity and malnutrition mainly micronutrient deficiencies are widespread across the country. There are human and economic cost implications of malnutrition (IFPRI, 2015). According to Black et al. (2013) the mortality of 45% of children below the age of five is attributed to malnutrition. IFPRI (2014) suggest that GDP total in Africa are less than 90% of its achievable levels in the absence of undernutrition.

The Zero Hunger Strategy adopted by the Ghana government was aimed at achieving food security and nutrition target of the SDGs. According to WHO and IFPRI (2015) Ghana is making good progress towards nutrition improvement. However, there is emerging challenge facing the country that has to do with a rising population whose diets are overly rich in calories and dense in saturated and trans fats. This has resulted in overweight and obesity and other relates noncommunicable diseases such as hypertension, type two diabetes, stroke, coronary heart disease. These constitute new challenges to public health and social protection policy (Ecker & Fang, 2016). Similar situations exist in many developing countries where it was estimated that death relating noncommunicable diseases is projected to increase by 15% between 2010 and 2020. Ecker and Asselt (2017) suggest that the northern part of Ghana needs more attention in national food and nutritional security strategies and policies.

Global Food Security Status

During the World food summit held in Rome in 1996 the world community reiterated its commitment to work together to eradicate hunger. Four years later eight development goals were set by the UN member states which included an ambitious goal of eradicating extreme poverty and hunger. This led the United Nations Assembly to declare its commitment to halve the proportion of people who suffer from hunger by 2015. The good news is that many countries have achieved the target or are very close to doing so and the bad news is that currently over 600 million people still face chronic undernourishment in the world today (FAO et al., 2020).

The global approach to eradicating hunger has not been the same. In the 1960s, when the population increase threatened to outgrow the food supply, the main solution was thought to be producing more food. Agricultural technologies introduced during the green revolution resulted in dramatic increases in food production, which helped to prevent food shortages and hunger in many places. The economic crisis that shocked the world between 1973 and 1975, with its attendant food crisis, was marked by wild fluctuation of food supplies and prices (Gerlach & Liu, 2010). In 1981, a Nobel Price-Winning economist named Amartya Sen showed that many countries faced famine amid abundance of food. It took Sen's work to show that access to the abundance of food produced was the problem (Moore & Sen, 1982). It became clear that to eradicate hunger, one must fight poverty and inequality.

In establishing the current food security status globally, FAO reported that there has been a slow increase in the number of people affected by hunger since 2014. Following this, in 2015 the countries of the United Nations committed to the 2030 agenda for sustainable development which looks beyond hunger to ensuring access to safe, nutritious, and sufficient food for all people throughout the year and eradicating all forms of malnutrition. It is estimated that currently there are nearly 60 million more undernourished people now than in 2014 and current estimates show that nearly 690 million people are hungry with about 381 million people found in Asia and more than 250 million in Africa, where the number of undernourished people is growing faster than in any other region of the world. Between 2018 and 2019 this number went up by 10 million people. The current state of food insecurity in the world is a result of economic conditions, extreme climate events, political instability and conflicts (FAO et al., 2020).

Adem et al. (2018) assert that political unrest and armed conflicts are key factors in food insecurity in Sub-Sahara Africa. That has prevented farmers from producing food. They further indicate that household size and food insecurity are positively related and therefore it is important that apart from food production strategies, awareness must be created of household size which has implications on the number of mouths to feed and the need for it to be controlled.

According to Adu et al. (2018), several agricultural development interventions have been implemented by different institutions and organisations as development strategies both nationally and regionally with both positive and negative outcomes. In this development effort, food security has remained paramount in international development cooperation. This has led to numerous agricultural related interventions in Africa.

In Ghana, although much progress has been made in poverty reduction, the problem of poverty and issues of food security still pose a development challenge especially in northern Ghana. In a study of agriculture and food security in northern Ghana Bawa (2019) indicated that the challenges in the agricultural sector are not only limited to cultivation, but also post-harvest losses, storage and marketing problems. Asuming-Brempong (2013) also indicated that unstable domestic production, high prices, and low incomes of households has contributed to food insecurity in Ghana.

2.10.3.1 Measurement of food security

Food security has been measured in a wide variety of ways. The specific indices chosen by a researcher would depend on several factors such as the specific component interested in, whether he/she is considering actual insecurity or vulnerability, qualitative or quantitative indices, and whether the study is to be carried out at the macro-, meso- or micro- level (country, intermediate/community, or household level). The focus of this study is at the micro-level. Due to the differences in definitions and understandings of the concept of food security, over 450 different indicators have been proposed. However, to reach some consensus on this subject, FAO held a Scientific Symposium on the Measurement and Assessment of Food Deprivation and Undernutrition in 2002 and the outcome of this was the fine-tuning of measures to focus on an assessment of how the world was progressing towards the fulfilment of Goal 1 of the MDG and specifically, Target 3 (FAO, 2002). Goal 1 was to eradicate extreme poverty and hunger, while Target 3 was to halve the proportion of individuals suffering from hunger in the period between 1990 and 2015. This symposium propounded five main methods (actually, systems) of analysis focusing on different aspects of the food security question, ranging from food availability and food intake to nutritional outcomes and hunger perception. For this study the methods deemed relevant for the present study are discussed as follows:

Qualitative Measures: When the United States was designing a survey in 1995 to measure food insecurity and hunger in the country, a new module was included. The objective of this module was to measure hunger using new, more practical dimensions dealing primarily with how hunger affects the lives of people and hunger outcomes (Bickel et al., 1998). Modules of this kind have now become quite mainstream in national household surveys and they have the advantage of being able to be used to predict vulnerability or the likelihood of households to either exit from or to fall into food insecurity. The major areas that are assessed in a qualitative food security measure include:

- If food consumption has been reduced recently for adults in the household
- If food consumption has been reduced recently for children in the household

- If there is increased anxiety about food availability
- If there is a reduction in food quality or perception of inadequate food quality.

Based on the results, a scale of food security could be drawn up ranging from only a slight worry about food to highly severe. The households could then be classified into Food Secure, Food Insecure without hunger, Food Insecure with moderate hunger and Food Insecure with severe hunger. Some studies that have used this module include Ashiabi (2005) and LeBlanc et al. (2005).

Crop Choice and Food Security: In the literature, the relationship between the choice to grow cash crops and food security outcomes varies widely based on the differences in the specific crops studied, the geographical spread of the research areas, and the existing local structures (Kiriti & Tisdell, 2004). In sub-Saharan Africa, cash-crop production has often been touted as a means to reduce poverty and improve food security (Jones & Gibbon, 2011), however it is unclear the precise conditions under which these ends can be achieved at the level of the household. Pierre-Louis et al. (2007) found positive association between diet diversity and the production of peanuts in Mali. Furthermore, Kuma et al. (2019) using a sample of 1600 smallholder coffee farmers in Ethiopia, have shown that coffee income was associated positively with the food security of farmers.

On the other hand, using a survey of 137 female respondents (63 of which were wives of a male household head) from a district in Central Kenya, Kiriti and Tisdell (2004) showed that cash cropping had a negative effect on per capita food availability in the male-headed households, but had the opposite positive effect on the female-headed households. They argued that since husbands had control over cash income, they were able to influence food purchases by sacrificing food for other expenses. Also, Kanyamurwa et al. (2013) used a cross-sectional comparative survey of 190 female coffee producers and 191 female food crop producers in a rural district of Uganda and obtained the result that coffee producers had more assets, greater income, made better use of markets, and had greater access to inputs. However, there was no significant difference in health care and the coffee producers had poorer dietary outcomes and greater food stress. Aragie et al. (2017) analyses some of these contrasts in results. Thus, with these mixed results, there is no clear expectation as to the eventual impact of crop choice on actual food security (even though there seems to be a consensus that growing cash crops improves incomes and amount of assets).

The number of days in the past week without food: As the name indicates, this measure contains the simple record of the number of days in the past week of recall in which the household had no food. This is a weighted average of all the individuals in the household with children having a higher weight of 0.75 and adults' weight of 0.25. This simple measure of food security neither captures the quantity nor quality of food available (as is done by the other measures), but it is a measure of the daily regularity of food supply within each household. Here, when the number of days without food is higher, this is an indication of a worse food security outcome. Other measures used by various institutions and organisations include:

1. Household Income and Expenditure Surveys
2. Food Consumption per capita
3. Squared Difference from the mean of Food Consumption per capita

4. Consumption Measure
5. Multidimensional Indicators
6. The FAO index
7. The Global Hunger Index
8. The Action Aid Hunger Scorecard Index

Vhurumuku (2014) indicated about seven (7) indicators for food security are to be collected at the household level. These include demographics, incomes, assets, expenditure, food consumption and coping, water resources, sanitation and access and health. He described two types of food security measurement.

1. Dietary diversity and food frequency: this type of metric captures the number of different kinds of food or food groups that people eat and the frequency with which they eat them. This results in the calculation of a score that represents the diversity of intake, but not necessarily the quantity.

2. Consumption behaviour: According to him these measures capture food security indirectly, by measuring the behaviours related to food consumption e.g., is the coping strategy index which counts the frequency and severity of behaviours in which people engage when they do not have enough food or enough money to buy food (Maxwell & Caldwell, 2008 cited in Vhurumuku, 2014).

FAO is responsible for assessing the food security situation in the world. In 2017, FAO included not only the International Fund for Agricultural Development (IFAD) and World

Food Programme (WFP) in the report “State of Food Security in the World”, but also the sister UN organizations; World Health Organisation (WHO) and United Nations Children’s emergency Fund (UNICEF) realizing the important link between food and agriculture with nutrition and health.

The most frequently used source for assessing the number of food-insecure people in the world is said to be the FAO report “the State of Food Security and Nutrition in the World” (FAO et al., 2017). The approach and indicators in this report have been partly changed from MDG 1 to accommodate SDG 2 (regarding nutrition). One of the measures used to track progress towards the 2015 hunger target is the estimate of how many people are undernourished. FOA calculates this every year for each country by analysing, how much food is available, how food is needed and by determining what proportion of the population may not have access to the food they need. It is useful for monitoring national and regional trends but does not identify who is undernourished and where they live. Other measurement tools were needed to get a more complete picture. To help build this gap, in 2013 FAO launched the voices of the hungry project and a new global tool called Food Insecurity Experience Scale (FIES) was born. The FIES provides information about the adequacy of people’s access to food and the severity of their food insecurity by asking them directly about their experiences.

According to Haug (2018) a new indicator that is included in SDG 2 is the qualitative assessment of how people themselves perceive their food security situation. This indicator assesses the prevalence of moderate or severe food insecurity in the population, based on the Food Insecurity Experience Scale (FIES). Under the FIES eight questions are posed as follows:

During the last 12 months, was there a time when:

- You were worried you would run out of food because of a lack of money or other resources?
- You were unable to eat healthy and nutritious food because of a lack of money or other resources?
- You ate only a few kinds of foods because of a lack of money or other resources
- You had to skip a meal because there was not enough money or other resources to get food
- You ate less than you thought you should because of a lack of money or other resources
- Your household run out of food because of a lack of money or other resources
- You were hungry but did not eat because there was not enough money or other resources for food

- You went without eating for a whole day because of a lack of money or other resources (Source: FAO-FIES)

This section of the literature review helped in selecting the choice of indicators and method employed in measuring food security (Haug, 2018). The choice of indicators identified include worry about running out of food because of a lack of money or other resources, inability to eat healthy and nutritious food, eating only a few kinds of foods, skipping a meal, eating less than one thought one should, household running out of food, hungry but did not eat, and went without eating for a whole day all because of a lack of money or other resources which is based on the FIES approach.

2.10.4 Well-Being as a component of poverty reduction

Well-being refers to situations that human experience but lays emphasis on the situation that should be available for people to attain wellbeing. Those are: that the needs of the person are fulfilled, gain their freedom, and achieve a better level of quality of life (Gough, 2007). Apart from this, McGregor et al. (2009) has defined well-being as "a better state of involvement with the community where needs are fulfilled, where one does things effectively to achieve their life objective, and where one can gain the happiness and gain the satisfaction with one's life". Gough (2007) definition of wellbeing touches on three basic concepts of well-being, which are: human needs, freedoms (or autonomy), and quality of life.

Well-being can be understood as how people feel and how they function, both on a personal and a social level, and how they evaluate their lives. To break this down, how people feel refers to emotions such as happiness or anxiety. How people function refers to things such as their sense of competence or their sense of being connected to those around them. How people evaluate their life is captured in their satisfaction with their lives, or how they rate their lives in comparison with the best possible life (New Economics Foundation, 2015). The well-being of farmers is driven by productivity and is also linked to food security and poverty alleviation (Darku & Malla 2010, as cited in Tran et al. (2016).

In recent years, literature show increasing interest about spiritual well-being, and its influences on physical, social, and psychological aspects of a people's life (Rovers & Kocum, 2010). Abdel-Khalek (2010) associated spiritual well-being with better quality of life and higher levels of happiness. In the same vein, Zadworna-Cieślak (2020) linked spirituality and satisfaction with life to health behaviour of people in long-term care institutions and found out that between spirituality and health behaviour, satisfaction played a mediating role. In a study to identify the relationship between spiritual well-being, perceived social support, and life satisfaction among university students in Jordan Alorani and Alradaydeh (2018) found a significant positive correlation between spiritual well-being with perceived social support and satisfaction with life.

Rovers and Kocum (2010) indicated that spiritual well-being is one of a core human component that provides driving force to give people fulfilment in life. Moberg (2002) defined spiritual well-being as "a sense of transcendence beyond one's circumstances, and other dimensions such as the purpose of life, reliance on inner resources, and sense of within-person integration or connectedness". According to Moberg (2002), spiritual well-being has two dimensions which are horizontal (existential) and vertical (religious) dimension. The horizontal dimension has to do with a person's sense of purpose in life, peace and life satisfaction, and vertical dimension related to the sense of well-being in relation to God or a higher power.

Cultural well-being is also an emerging research area, with a number of specific aspects such as fostering participatory activities which develop social capital and a sense of place and togetherness as well as general economic development. Andrews (2014) posit that culture has been identified as making an important contribution towards helping individuals and communities out of poverty. Well-being and culture are said to be complex and a relatively new area of research focus. As a result research on the topic is varied (Gott, 2020).

According to Gott (2020) culture is a complex idea to define, however, it is worthwhile to consider the different activities which are used as examples of culture. These activities include theatre and dance, film, visual arts, photography, archives, storytelling, painting, listening to music and museum trips which lead to a wide heterogeneity in the research base (Gott, 2020). (Welsh Government, 2016:10) defined culture as 'not just the arts, but also heritage and the historic environment, including the contribution of museums, libraries and the media'. Although the definition is relatively broad and can create difficulties for research, Grossi et al. (2012) indicate that several quantitative studies have demonstrated that attendance and participation in cultural activities are important factors that predict high well-being. Gott (2020) indicate that different groups of people undertake cultural activities in different ways, however attending or participating in a wide range of cultural activities plays a role in predicting high well-being of individuals. In a study to explore the relationship between culture and well-being Gott (2020) found that attending arts, cultural or heritage activities three times or more per year means that you are 23% more likely to report high life satisfaction.

2.10.4.1 Measurement of well-being

In a study to assess the relationship between farmer field schools and wellbeing, Friis-Hansen and Duveskog (2012) used a selection procedure to elicit people's perceptions of wellbeing, extrapolated them into clusters, validated, and combined them into a poverty index. The methodology has four steps: in step one, expressions of well-being are collected through qualitative interviews of groups of people geographically representing a given area. Small groups of informants are asked to rank all households in their community into three groups using a card-sorting method and thereafter asked to describe the well-being of each group. Step two transforms these statements into several thematic well-being indicators each comprising a set of generally agreed perceptions describing the situation of non-poor, poor, and very poor for each of the indicators. Step three is to translate these indicators into questions in a household questionnaire. Step four is to develop a poverty index based on the poverty indicators. A household's poverty index is computed as the mean of its scores for each of the wellbeing indicators (Friis-Hansen, 2005 as cited in Friis-Hansen & Duveskog, 2012).

Wu et al. (2010) used propensity score matching method to evaluate the effect of improved upland rice variety adoption on farmers' wellbeing using household data. They used four indices to analyse farmers' wellbeing namely, average household income, the incidence of poverty (the head count ratio), the poverty gap and the severity of poverty. They found out that upland rice technology had a robust and positive effect on farmers wellbeing. They also observed that the effect of technology on wellbeing showed a diminishing impact over time (not sustainable). They, therefore recommended that agricultural technology needs to be generated and promoted continuously to replace older technologies.

In a study to assess household welfare effects of agricultural productivity, Dzandu (2015) found little evidence that when productivity increases household welfare is assured. He opined that although it is useful to improve productivity of households, current levels of productivity need to be improved significantly to improve household welfare.

Stone (2012) used the Satisfaction with Life Scale (SWLS) to assess well-being. The statements were based on a three-point Likert scale. In this study well-being is a latent measure. This study therefore adopted the SWLS and used a three-point Likert scale as follows: Disagree=1 Neither agree nor disagree=2 agree=3. The statements are as follows:

- In most ways, my life is close to my ideal.
- The conditions of my life are excellent.
- I am satisfied with my life.
- So far, I have gotten the important things I want in life.

- If I could live my life over, I would change almost nothing.

  This section of the literature review helped in understanding the concept of well-being and informed the approach used in its measurement. The approach adopted for this study is the SWLS.

2.11 Chapter summary

This chapter has considered current literature on the main variables of this study which include, farmer participation in agricultural projects, farmer innovative performance, agricultural productivity, the key concepts to measure poverty reduction (improved incomes, food security, and well-being). The literature review revealed various methods used in measuring these concepts that informed the methods adopted for this study. This study used crop yield in kilograms per hectare to measure productivity, crop income to measure farmers' income, the food insecurity experience scale to measure food security and satisfaction with life scale to measure well-being. The literature revealed government policies that have been implemented in the past to tackle poverty and their effects which provided an understanding of progress made in the effort to tackle poverty and how the USAID FtF initiative fits into the strategy of poverty reduction in Ghana. The literature also revealed the projects that have been undertaken under the FtF initiative in Ghana which informed the selection of the capacity building projects for this study.

CHAPTER THREE

METHODOLOGY

3.1 Introduction

The study was guided by its research objectives which sought to address the three research questions posed. The chapter highlights the study design, population of the study, sampling, data collection, data analysis, and reviewed literature on methods used in addressing key concepts of the research objectives.

The use of both qualitative and quantitative methods for this study was encouraged because Pansiri (2006) and Rutger (2007) for example used them to evaluate some capacity building projects in developing countries. The quantitative aspects dealt with hard facts such as the quantity of deliverables and used the qualitative aspects to assess the quality of the deliverables in the projects they assessed. This study employed a similar method to assess what has been achieved and the quality of those achievements under the FtF capacity building initiative in which data was obtained from interviews, focus group discussions and structured questionnaires.

3.2 Study location

The field work was carried out in all the five northern regions namely Northern, Savannah, Upper West, Upper East, and North East regions. Information rich districts, that is those with high concentration of the capacity building projects under study, were selected from each of the regions for the specific projects. Table 3.1 presents the regions, districts and the communities from which data was collected based on the projects.

Table 3. 1 Communities and number of respondents selected from the regions and districts for the study

Region	District	Communities	Number of respondents
Northern	Savelugu	Ying	24
		Moglaa	16
		Kanshegu	15
		Libga	6
North East	West Mamprusi	Zangum	17
		Wulugu	10
		Loagri	12
		Silinga	8
		Nabari	2
Savannah	Damango	Soalepe	16
		Canteen	15
	Sawla-Tuna	Gindanbour	67
Upper East	Bawku	Kpalorie 1&2	14
		Yakin	3
		Kuka	3
	Binduri	Bazua	12
		Atuba	22
Upper West	Sissala East	Buguelle	16
		Bandei	16
	Lawra	Amburi	6
		Paavu	6
		Orbili	8

Source: Field Data (2020)

Figure 3.1 is a map of northern Ghana showing the regions, districts, and communities where the study was undertaken.

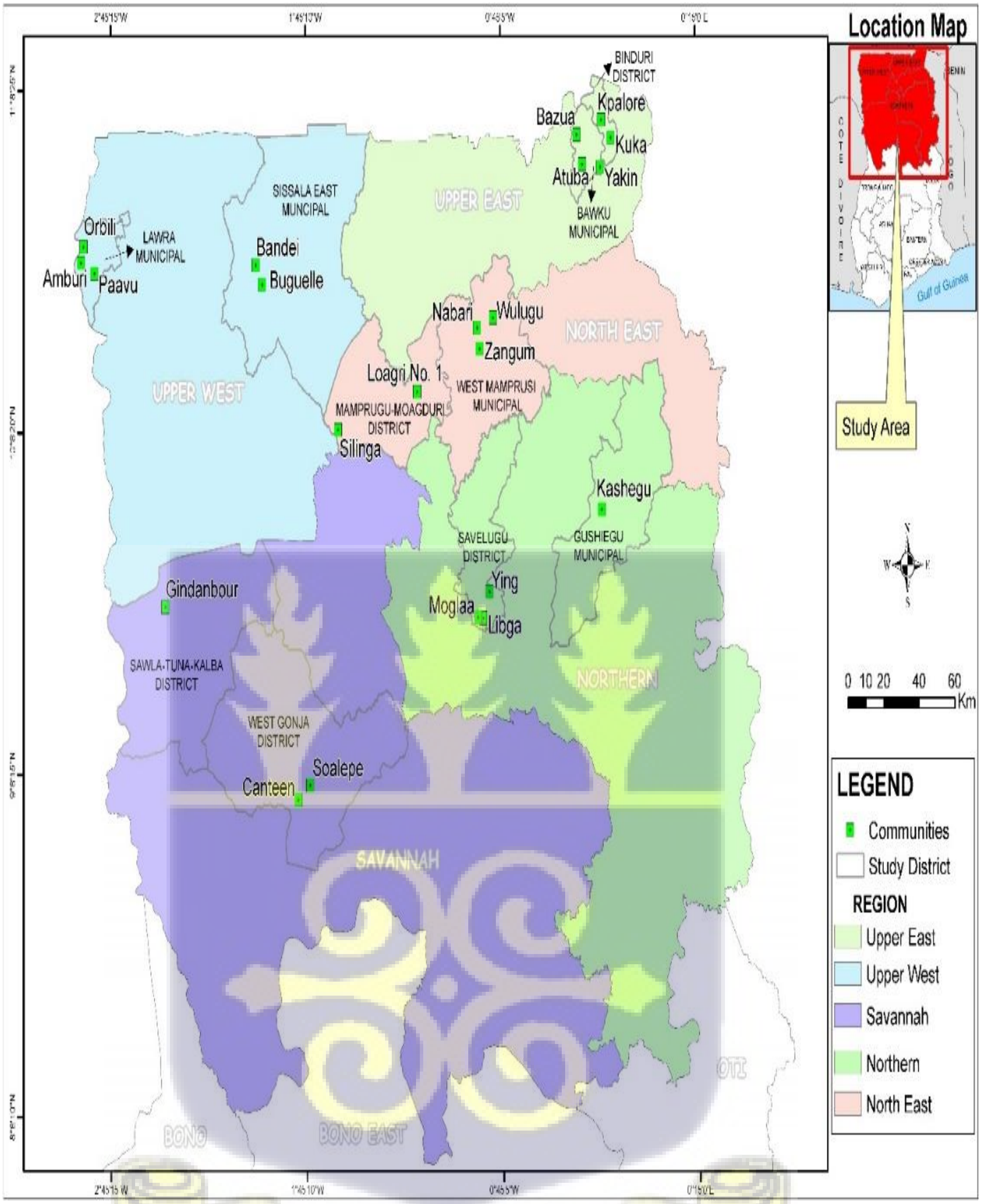

Fig. 3. 1 Map of study locations in Northern Ghana (Centre for Remote Sensing and Geographic Information Services (CERSGIS)

3.3 Research Philosophy

On a more philosophical level, mixed methods research combines paradigms, allowing investigation from both the inductive and deductive perspectives, and consequently enabling researchers to combine theory generation and hypothesis testing within a single study (Jogulu & Pansiri, 2011). Although there are other philosophical perspectives which include critical realism, transformative-emancipation and dialectical pluralism, pragmatism seems to be the popular perspective underpinning mixed methods research studies which was adopted for this study.

3.4 Research Approach

Research involves a systematic study of a problem using a strategy starting with an approach which entails the design of hypotheses, methods and techniques to be employed, development of data collection instruments, data processing, data interpretation and the prescription of solutions to the problem. There are several research approaches to pursue a research project, namely, quantitative, qualitative, and mixed methods (Grover, 2015). In this study a mixed method approach was adopted, and data was collected using both quantitative and qualitative methods and analysed using quantitative and qualitative methods. Questionnaires were employed for the quantitative data collection while FGD and in-depth interviews were used for the qualitative data collection. In the qualitative data analysis thematic and content analysis were used while, descriptive statistics, multiple regression, chi-square OLS, Wilcoxon sign ranked test and Kruskal Wallis tests were used for the quantitative analysis.

3.5 Research Design

This is a mixed method research design, employing mainly qualitative and quantitative methods of enquiry because Creswell and Clark (2018) observed that mixed methods allow the researcher to capture information that only quantitative or qualitative methods may not capture. The study used qualitative methods alongside quantitative methods because researchers have suggested that one approach could be used to better understand, explain or build on the results from the other approach. For example, qualitative methods are more effective, insightful and convincing while the quantitative methods are useful for further assessment of the significance and relevance of qualitative findings (Babbie, 2016). Qualitative methods enable researchers to collectively engage FGD respondents such that questions could be formulated and asked spontaneously as the interview progresses. It also allows respondents to express their opinions freely. The quantitative measure considers literate respondents who may be scattered over geographical areas (Bonye et al., 2012).

3.6 Ethical Consideration

The study was guided by a set of principles elaborated by Bryman and Bell (2007). Some of these principles include voluntary participation, informed consent, anonymity, confidentiality, potential for harm, and results communication (Fleming & Zegwaard, 2018). The researcher sought ethical clearance from the University of Ghana, Legon and issued consent forms to the participants to sign. The purpose of the study was explained to the participants and participants were assured that all information collected will be kept confidential and used only for the intended purpose and would be kept anonymous. Care was also taken not to ask offensive questions. Participants were informed that the results of the study will be shared.

3.7 Population of study

A study population as defined by Babbie (2016), is the theoretically specified aggregation of survey elements in a study area. Thus, all farmers who participated in the selected capacity building projects form the population of the study.

3.8 Sampling and sampling size

A multi-stage sampling approach was adopted in this study at the regional and district levels. At least one district was selected from each of the five regions. Information rich district on each of the project were selected. Due to the widespread nature of the projects' districts and communities and budgetary limitations a sample of 314 was used. The communities were purposively selected and out of the sampled communities for each project, respondents were randomly selected for each project ensuring gender balance as shown in the results.

For the selected districts the total number of the participants for the four projects was 296, 612 which was used as the population.

Following Yamane, (1967), the sample size is estimated using the following information.

$n = \frac{N}{1+N(e)^2}$ where n is the sample size, N is the population size and e is the margin of error, assuming 5 percent margin of error and 95 percent confident level, the sample size is computed.

Table 3. 2 Sample size determination for each project

PROJECT	POPULATION	SAMPLE SIZE PER PROJECT	PROPORTION	DISTRIBUTION
Sahel Grains	5,210	371	0.02	7
ADVANCE	126,062	398	0.43	170
USAID/UG FTF	90	73	0.00	0.12
ATT	165,250	399	0.56	222
TOTAL	**296,612**	1241	1.00	399

Source: Field Data (2020)

In determining an appropriate sample size for each project, the proportionate sample size determination approach was used. This was done by dividing each project population by the total project population (sum of all the four projects). Two of the projects, ATT and ADVANCE had sample sizes of 222 and 170 respectively. However, Sahel and USAID/UG FtF Projects had sample sizes of 7 and less than one (0.12) respectively. The sample sizes for SAHEL and USAID/UG FtF projects were so small which will make it difficult for any conclusions and generalisation. It was decided that more samples be determined for the minority projects. However due to logistical constraints the majority projects were reduced and that of the minority groups increased to enable generalization and conclusions to be drawn. Due to the widespread nature of the projects, time, and budgetary limitations a sample of 314 was used composed of 96 participants for the

ADVANCE, 91 participants for ATT Projects, 67 participants for Sahel Grains and 60 for the USAID/UG FtF Project. In selecting respondents, the simple random sampling technique was used.

3.9 Unit of Analysis

"Units of analysis are those units that are initially described for the ultimate purpose of aggregating their characteristics in order to describe some larger group or explain some abstract or phenomenon. It could be an individual, group or organization" (DeCarlo, 2018:118). The unit of analysis forms the actual entity to be analysed in the research. The units of analysis in this study are individual men and women project participants.

3.10 Development of data collection instruments

This study employed various data collection mechanisms. A desk study was conducted to identify projects involved in capacity building activities under the FtF initiative and their impacts. Relevant literature was reviewed from project documents, such as project proposals, project semi-annual and annual reports, project completion reports and evaluation reports as well as workshop reports.

A checklist was developed for focus group discussions and a structured questionnaire was also developed and uploaded unto the Open Data Kit (ODK) collect app which is a Computer Assisted Personal Interviewing (CAPI) technique. Enumerators were trained well in advance on the use of the app for data collection using tablets and mobile phones.

3.11 Pre-testing of data collection instruments

Pre-testing of structured questionnaires was undertaken to validate the information gathered from both the focus group discussions and the key informants' interviews. The pre-testing also helped to ensure that the respondents interpreted the questions properly and to enable the interviewer to get a feel of the range of answers that were likely to be given. The questionnaires developed were pre-tested in September 2020 in Lawra, West Mamprusi and Bawku Municipalities to check for reliability and validity of the questions to ensure the right information was collected. The questionnaire was too bulky and took over three (3) hours to administer to one respondent. The questions on total productivity measurement which took over two hours to administer was taken out and yield per acre was used (land productivity). This helped in reducing the time on each questionnaire to about 45 minutes.

3.12 Validity

Validity refers to "the extent to which an empirical measure adequately reflects the real meaning of the concept under consideration" (Babbie, 2016). Kumar (2011) explained earlier that validity is the concept of appropriateness and accuracy that is applied to a research process, and it is concerned with the accuracy of the measurement. Therefore, in order to be sure a research instrument measures what it intends to measure validity is needed (Kothari, 2004). In this study the data collection instrument was designed to collect enough and relevant information to be able to measure the various concepts. Therefore, a set of questions were asked to gather adequate data about each construct in each of the objectives to establish validity. To ensure validity both quantitative and qualitative methods were employed as suggested by Cohen et al. (2007).

3.13 Reliability

Reliability "is a matter of whether a particular technique, applied repeatedly to the same object, yields the same result each time" (Babbie, 2016). To ensure consistency in the measurement of constructs, the data collection instrument was subjected to a reliability. Cronbach's Alpha test is used statistically, as a reliability test and can be measured with a value range of 0-1. Values less than 0.6 are considered unacceptable whereas values ranging between 0.7-1 are regarded as very suitable (Burn & Burn, 2008). Wolson (2014) indicated that in conducting research it is essential to combine reliability with validity. Reliability was employed in the construct of food security and well-being in this study.

3.14 The Field Work

In this section the various steps (and the reasons behind them) taken in carrying out the field work, how and why the sites were chosen, the development and use of the main data collection instruments are thoroughly described. The potential constraints identified during the data collection are also discussed.

An initial desk study was conducted to identify the capacity building projects of USAID FtF Initiative undertaken in northern Ghana. This involved visits to the Monitoring and Evaluation Technical Support Services of USAID to interact with the monitoring and evaluation specialists to identify capacity-building projects under the FtF initiative for the study. The researcher followed up with actors at USAID as to the projects of interest-based upon which contacts of key personnel on the different projects were obtained. The location of the projects was also identified involving the districts and the communities where the activities of the projects were undertaken. The researcher first had a telephone conversation with some of the staff of the projects who gave information on activities undertaken under the project. This was followed by a reconnaissance visit to the field to obtain first-hand information about the activities undertaken with the participants of each project. The researcher had in-depth interviews with a farmer under the ADVANCE Project in Bawku Municipal. This was followed by another in-depth interview with a farmer in Zebilla who participated in both ADVANCE and ATT projects. The interviews bothered on those who were involved in the projects, activities undertaken with farmers and the benefits of the projects so far. Two focus group discussions were also held in West Mamprusi District with 10 farmers who participated in ADVANCE project and 10 farmers who also participated in the ATT project to triangulate information gathered from documents, project staff and the participants themselves. This helped with the gathering of relevant information for the development of the data collection instruments for the study as described earlier.

3.15 Data collection

The data for the studies were obtained through questionnaire administration to farmers who participated in the four projects (Plate 3.1a). Focused group discussions (Plate 3.1b) and in-depth interviews with opinion leaders were held in the communities. The in-depth interviews focused on activities undertaken with the farmers and project benefits to the communities after capacity building activities of the projects.

a b

Plate 3. 1 Individual interview at (a) Gindanbour and Focus group discussion at (b) Libga, Savelugu

3.15.1 Focus Group Discussions

As mentioned earlier in section 3.12, two (2) focus group discussions were held at the exploratory stage of the study to elicit information that helped in the preparation of the questionnaires for the survey. To get more insights into the responses and for further enquiries about the concepts and issues being studied, four (4) focus group discussions were conducted with selected farmers for each project with the help of interpreters. On the average there were 8 people (four males and four females) involved in the focus group discussions for each project. The discussions focused on the nature of group meetings to discuss project implementation as well as issues that bordered on project accountability, transparency, quality of communication, appropriateness of scientific knowledge, and the appropriateness of sharing local knowledge within the project activities. The understanding of innovative performance, productivity, and how innovative performance helped in improving productivity were all discussed. Groups understanding of income and how productivity contribute to income was also discussed. Also, group understanding of food security and how productivity contributes to food security was discussed. In a similar vein group understanding of well-being and how productivity improves well-being was also discussed. Some of the results of the quantitative analysis were investigated further through the focus group discussion. The information gathered were used in discussing and supporting findings of the survey.

3.16 Data Analysis

Data analysis software such as excel, and SPSS were employed to analyse the data collected. Both quantitative and qualitative methods (Creswell & Clark, 2018) were employed in the data analysis. The quantitative survey data was analysed using descriptive statistics such as frequency distributions, cross-tabulations (chi-square), and regression analysis to determine relationships between the variables. Qualitative data from open-ended responses as well as focus group discussions and interviews were analysed using thematic and content analyses. The results are presented in tables and graphs.

Statistically, reliability was measured using Cronbach's Alpha test with a value range of 0-1. Values less than 0.6 are considered unacceptable whereas values ranging between 0.7-1 are regarded as very suitable (Burns & Burns, 2008). This range of values are acceptable for a question that number 10 and above. However, if the questions are below 10 then values from 0.5 and above are considered acceptable. Cronbach Alpha was used to test the validity of the questions used in the construct of Innovative performance, food security, and well-being.

3.16.1 To determine the influence of farmer participation in the project activities on their innovative performance.

To address objective one (1) a cross-tabulation was undertaken to identify relationships between the dependent variable Innovative performance (low, medium, and high) and the independent variable participation (low, partial, and full). To determine the level of participation, the respondents were asked questions pertaining to their participation in project implementation meetings, field demonstration activities and group activities and then the researchers facilitated the farmers' ranking their participation as low, partial, and full. To determine IP eight variables were selected and used as a measure of IP. These variables include, knowledge levels, level of practices, information sharing; contribution to discussions and decision making related to the USAID Feed the Future project at your FBO or CBO meetings, talking to other people about knowledge or information acquired from participating in the USAID Feed the Future Project, making any contributions to local stakeholder platforms using inputs from the USAID Feed the Future Project, experimenting, attracting resources to the community, and making resources available to aid the community.

To measure knowledge, the farmers were asked a series of questions that varied according to the project's activities undertaken and were based on good agronomic practices. A score of one (1) was awarded for each correct answer and no score (0) for the wrong answer. The answers were evaluated, and their total knowledge scores were calculated. Subsequently the respondents were categorized into three such as: high knowledge, partial knowledge and low knowledge based on the score. For the ADVANCE project there were ten questions. For the ATT project there were seven (7) questions. The Sahel Grains project had nine (9) questions. For the USAID/UG FtF project there were 13 questions. A score between 0 and 30.33% was termed low, above 30.33% but below 60.33% was termed partial and above 60.33% was termed high knowledge for each of the projects. Similarly, for practicing there were 13 items and a score of one (1) was awarded for yes and zero (0) for any other response (no or not sure). A score between 0 and 30.33% was termed low practice, above 30.33% but below 60.33% was termed partial practice and above 60.33% was termed full practice.

To measure innovative performance, a Principal Component Analysis (PCA) was used to verify which of the eight indicators contributed most to IP. Within the PCA knowledge gave an absolute coefficient below 0.1 and therefore was taken out. The results indicated that knowledge did not contribute much to IP because it had the least coefficient and therefore it was dropped. The indicators with high coefficients were sharing of the knowledge and utilisation of knowledge which gave a good measure of IP. Therefore, the good measures of IP were knowledge utilisation and sharing.

Although there were three-factor scores the first-factor score was used because most often it gave the highest scores. PCA creates a regression model that generates the factor scores for categories, and this was used in the categorisation. A score between 0 and 30.33% was termed low IP, above 30.33% but below 60.33% was termed medium IP and above 60.33% was termed high IP.

A Chi-square analysis was conducted to determine any relationship between participation and innovative performance. The chi-square test is used when there are two (2) categorical variables with at least two (2) categories in each variable. In this case both IP and participation had three categories each and therefore Chi-square tests were appropriate to apply (Dancey & Reidy, 2017). The Chi-Square test was carried out using the general Chi-Squared equation.

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

Where:

O = The observed frequencies
E = Expected frequencies
The main reason was to determine the existence of any significant difference among the different levels of participation and IP.

3.16.2 To ascertain the effect of farmer innovative performance on crop productivity.

The Wilcoxon Signed-Rank test, a non-parametric test was employed because the mean was violated due to outliers in the data set. The Wilcoxon Signed-Rank test takes into consideration a median comparison of any two independent paired data and measures the significant difference between two independent continuous variables. It is used when you have the same or matched participants in both conditions. The Wilcoxon Signed-Rank is equivalent to the Mann–Whitney, although the formulae for the two tests are slightly different, because in the Wilcoxon we can make use of the fact that the same participants are performing in both conditions (Dancey & Reidy, 2004: 535). A statistical significance was set at $p<0.05$.

The formular is as follows:

$$W=\sum_{i=1}^{N_r}\left[\operatorname{sign}\left(x_{2,i} - x_{2,i}\right)\cdot R_i\right]$$

Where:

W = test statistic
N_r = sample size, excluding pairs where $x_1 = x_2$
sign = sign function
$x_{2,i}$, $x_{2,i}$ = corresponding ranked pairs from two distributions
R_i = rank i

3.16.3 To ascertain the relationship between crop productivity and income

The third objective set out to identify any existing relationship between farmers' crop yields and their incomes. This section discusses the analytical methods employed to address the objective.

We used the Wilcoxon Signed-Rank test to show whether there is significant difference between before and after yields for each crop.

Income was treated as the total earnings based on the three selected crops (maize, rice, and soybean) before the projects and after the project in the 2019 cropping season.

The Ordinary Least Squares (OLS) regression was used to estimate the relationship between yield (independent variable) and income (dependent variable) of the farmers.

$$Y^{I} = a + bX + \mathcal{E}$$

Where Y^{I} is income, X is yield and a and b are parameters in the regression model, and $\mathcal{E}$ is the error term.

3.16.4 To determine the relationship between crop productivity and food security

For this study, the questions were eight in number and the Cronbach's Alpha value was 0.95. In measuring food security, the key food security pillars were availability, accessibility and utilisation and therefore eight questions were asked, and the responses were captured with a binary response where yes was one (1) and no was (0) (Haug, 2018). Based on the eight questions asked to measure food security, values were obtained ranging from 0 to 8. The responses were averaged resulting in a score range of 0 to 1. A value approaching one (1) indicates food insecurity and food security values approached zero. Therefore, values ranging from 0 to 0.39 were adjudged food secure and those ranging from 0.4 to 1 were adjudged food insecure. The key food security pillars include accessibility, availability, utilisation, and stability.

The Kruskal-Wallis test is used and is a nonparametric test to compare outcomes when there are two or more independent groups ($k \geq 2$) (Wu & Guan, 2015). It is used to compare medians among k comparison groups. A statistical significance was set at $p<0.05$.

The formular for the Kruskal Wallis test is as follows:

$$H = \left(\frac{12}{N(N+1)} \sum_{j=1}^{k} \frac{{R_j}^2}{n_j} \right) - 3(N+1)$$

where k=the number of comparison groups

N= the total sample size

n_j is the sample size in the j^{th} group and

R_j is the sum of the ranks in the j^{th} group

The Kruskal-Wallis test was used to determine any significant difference between those that are food secure and those that are not.

3.16.5 To determine the relationship between crop productivity and well-being.

The farmers were asked to respond to five statements adopted from the Satisfaction with Life Scale (SWLS) (Stone, 2012) either to agree or disagree on a 3- point Likert scale as follows: Disagree=1 Neither agree nor disagree=2 agree=3. For this study, the statements were five in number and the Cronbach's Alpha value was 0.930. From the responses a choice of 1 or 2 was adjudged well-being not improved which was assigned a value of 0 while 3 was adjudged as improved well-being and assigned a value of 1.

The scores ranged from 0 to 5. The responses were averaged resulting in a score range of 0 to 1. A value approaching one indicates improved well-being and unimproved well-being values approached zero. Therefore, values ranging from 0 to 0.39 were adjudged unimproved well-being and those ranging from 0.4 to 1 were adjudged improved well-being.

The Kruskal-Wallis test was used to test the relationship between crop yield and well-being. A statistical significance was set at $p<0.05$.

Table 3.3 presents the variables identified, the associated indicators, and the analytical tools employed for each objective.

Table 3. 3 Methodological Framework: Summary of study objectives, variables, indicators, and the analytical tools employed

Objectives	Variables	Indicators	Analytical Tools
To determine the influence of farmer participation in the project activities on their innovative performance (IP).	Participation	• Project activities participated in • Level of Participation • Definition and measurement of innovative performance of farmers	• Frequencies and percentages • Cross tabulation to see relationships between the independent (farmer participation) and dependent (innovative performance) variables. • Chi-square
To ascertain the effect of farmer innovative performance on crop productivity.	Innovative performance	• Level of knowledge (Low, partial, full knowledge) • Application of the knowledge in farming (practice) • Experimenting • Attracting resources to aid community • Making resources available to the community **<u>Information sharing</u>** • Contributed to discussions and decision making related to the USAID Feed the Future project at your FBO or CBO meetings • Talked to other people about knowledge or information acquired from participating in the USAID Feed the Future Project	• Principal Component Analysis (PCA) • Wilcoxon sign rank test

		• Contributions to local stakeholder platforms using inputs from the USAID Feed the Future Project	
To ascertain the relationship between crop productivity and income.	Productivity	• Crop quantity/yield harvested in kilograms per hectare The study adopted the partial productivity measure. Productivity = Crop output per acre	
	Income	Income: • Crop farm income before and after the project	Ordinary least square regression **Dependent variable** (continuous) • Income **Independent variable** (continuous) • Yield in kilograms per hectare (Productivity)
To determine the relationship between farmer crop productivity and food security	Food security	Binary response to the statements: during the last 12 months, was there a time when, because of lack of money or other resources: • You were worried you would run out of food? • You were unable to eat healthy and nutritious food? • You ate only a few kinds of foods? • You had to skip a meal?	Frequencies, percentages and the Kruskal-Wallis test **Dependent variable** (Dichotomous scale: Food secure or food insecure) • Food security **Independent variable** (continuous or categorical) • Yield in kilograms per hectare (Productivity).

		• You ate less than you thought you should? • Your household ran out of food? • You were hungry but did not eat? • You went without eating for a whole day?" (Haug, 2018)	
To determine the relationship between crop productivity and well-being.	Farmer's Well Being	Response to five statements either to agree or disagree on a 3- point Likert scale as follows: Disagree=1 Neither agree nor disagree=2 agree=3. The questions are as follows: • in most ways my life is close to my ideal. • The conditions of my life are excellent. • I am satisfied with my life. • So far I have gotten the important things I want in life. • If I could live my life over, I would change almost nothing (Stone, 2012)	Frequencies, percentages and the Kruskal-Wallis test • **Dependent variable** (Dichotomous scale: Improved well-being or not improved well-being) • **Independent variable** (continuous or categorical) Yield in kilograms per hectare (Productivity)

3.17 Strengths, Weaknesses, and Limitations of Study

The study and its findings were strengthened by the fact that several methods were employed to gather data. The triangulation of these data and the methods of analysing them, served as an important strength of the study. Despite these strong points, academic studies such as the current one, usually come with their challenges, weaknesses, and limitations, and indeed cannot be deemed to be perfect. First, it was quite a bit of a challenge to obtain some information from USAID and the Project Staff. Most of the projects had ended and so it was difficult to locate project staff since key project staff had moved on and were not obliged to give out documents or respond to questions. The team were however supported by the MOFA staff in the study locations.

Language served as a limitation to the study. All the measuring instruments (in-depth interview guides, interview guides for focus group discussion, structured questionnaires) were prepared in the English language. Most of the farmers were not proficient (or even do not have any knowledge) in the English language, hence it was difficult getting interviewers from the localities who were fluent in the English language and the local dialects. Because some of the projects had relatively small population, the sample size determination for each project was challenging but used sample sizes that would enable generalisation of the findings of the study. Survey recall bias was a limitation of this study. This was because farmers were asked information from a period in the past which may lead to providing less-than-truthful response. This may result in farmers giving a bias or less-than-truthful responses to questions, just so they appear worse off than they are in the hopes that doing so may help to attract some donor support or they may want to appear better off than they are for fear of being judged by enumerators. However, farmers were provided with clear information about why they were being interviewed. They were assured that information obtained from them would be highly treated as confidential.

At a point in time the research team encountered armed robbery on the Sawla-Fofulso stretch of the Tamale-Wa Road and the timely intervention of the police saved the situation. The team was escorted to safety. It was also challenging to travel to all five regions.

3.16 Chapter Summary

This chapter outlined the research philosophy, design, approach, and the methods adopted to select samples for the collection of relevant data from the project locations and the tools employed to analyse the data to address the research objectives. It also presented a methodological framework to summarise the study objectives, variables, indicators, and tools employed for the study. It also presented the strengths, weaknesses, and limitations of the study.

CHAPTER FOUR

FINDINGS AND DISCUSSIONS

4.1 INFLUENCE OF FARMERS' PARTICIPATION IN AGRICULTURAL CAPACITY BUILDING PROJECTS ON THEIR INNOVATIVE PERFORMANCE

4.1.1 Introduction

This chapter presents findings of an investigation into how smallholder farmers' participation in the selected USAID FtF capacity-building projects' activities influenced their innovative performance. It begins by presenting and discussing the socio-economic characteristics of the respondents. It also discusses the levels of participation of respondents in the various projects as well as whether they exhibit innovative performance or not. Finally, how respondents' participation influenced their innovative performance is explored and discussed.

4.1.2 Description of the sample

Table 4.1 summarises the characteristics of the respondents of the survey. Most of the respondents (61.1%) were males, and the ages of the respondents ranged from 17 years to 77 years with a mean age of 44.3 years. The results show that most of the respondents (71%) fall within the age bracket of 36 years, and above which is an indication that majority of the respondents are within the adult category (36 years and above). This may be because of the poor attitude of the youth towards agriculture which has implications for their participation in agricultural projects (Gangwar & Kameswari, 2016). According to the youth policy in Ghana, youth classification is within the ages of 15 to 35 years (Ministry of Youth and Sports, 2010). The result is contrary to a study by Yeboah and Jayne (2020) which indicate that agricultural workforce in SSA range from 32 to 39 years. That study sought to debunk the idea that SSA farmers are over 60 years.

Table 4. 1 Socio-economic characteristics of the respondents.

SOCIO-ECONOMIC	CATEGORIES	FREQUENCY	PERCENTAGE
Sex	Male	192	61.1
	Female	122	38.9
	Total	314	100
Age group (years)	16 - 25 years	23	7.3
	26 - 35 years	68	21.7
	36 - 45 years	89	28.3
	Above 45 years	134	42.7
	Total	314	100
Marital status	Married	264	84.1
	Divorced	1	0.3
	Widowed	29	9.2
	Single	19	6.1
	Total	314	100
Had formal education	Yes	116	36.9
	No	198	63.1
	Total	314	100
Highest level of education	Tertiary	12	10
	Vocational	7	6
	Senior High	39	34
	Basic	58	50
	Total	116	100

Source: Field Data (2020)

It was observed that majority (84.1%) of the respondents were married while 6.1% were not married. Njeru and Mwangi (2015) noted that rural women especially young females are restricted by culture in the participation in training and learning activities. In the northern part of Ghana marriage influences women participation in agricultural activities

(Britwum & Akorsu, 2016). With regards to educational background, 63.1% of the respondents had no formal education. Out of those who had formal education, 50% had basic education as their highest level of education. There were 34% of the respondents who reached senior high school while only 10% of the respondents got to the tertiary level and only 6% reached the vocational level. The study revealed that more people who had no formal education participated in the capacity building projects contrary to suggestions by Nnadi and Akwiwu (2008) that when farmers are educated it is more likely for them to participate in agricultural projects.

Table 4.2 summarises the demographic information about the respondents of the survey. The selected USAID capacity-building projects were implemented in all five regions in northern Ghana. About 31% of the respondents were from the Savannah region with 15.9% from the North East region. In all the eight selected districts and Municipalities the highest number of respondents (21.3%) were in the Sawla Tuna Kalba District. With a mean of 10.4, household size ranged from 1 to 31. About 58.3% of the respondents had household sizes of 5 to 10 people, while 35% were above 10. It is typical to find smallholder farm families with large household sizes in northern Ghana that serve as a source of agricultural labour (Bawa, 2019). If not for capacity building activities, engaging in farm labour is how the tradition of farming is passed on to the next generation. Apart from engaging in farm labour to acquire knowledge and skills, agricultural extension advisory services serve as an avenue for knowledge development and access through which extension workers encourage farmers to participate and adopt innovations (Chindime et al., 2017). Farming experience of the respondents ranged from 1 to 65 years with an average year of 21.8 years. This gives an indication of how experienced the respondents are. As a result, their indigenous knowledge should play a role in the learning and interaction processes and outcomes of the projects' capacity building activities.

Table 4. 2 Demographic information of the respondents

DEMOGRAPHIC	CATEGORIES	FREQUENCY	PERCENTAGE
Region	Northern	60	19.1
	North East	50	15.9
	Upper East	54	17.2
	Upper West	52	16.6
	Savannah	98	31.2
	Total	**314**	**100**
District	Bawku Mun.	21	6.7
	Binduri Dist.	33	10.5
	Damongo Dist.	31	9.9
	Lawra Mun.	20	6.4
	Savelugu Dist.	60	19.1
	Sawla Tuna Kalba Dist.	67	21.3
	Sissala East	32	10.2
	West Mamprusi	50	15.9
	Total	**314**	**100**
Household size	Less 5	21	6.7
	5 - 10	183	58.3
	Above 10	110	35
	Total	**314**	**100**
Number of years of farming experience	1 - 10 yrs	86	27.4
	11 - 20 yrs	83	26.4
	21 - 30 yrs	81	25.8
	31 - 40 yrs	49	15.6
	Above 40 yrs	15	4.8
	Total	**314**	**100**

Source: Field Data (2020)

4.1.3 Farmer participation in the project activities

The FtF projects sought to improve farmers' productivity by introducing them to Good Agronomic Practices (GAP) for the production of maize, rice and soybeans. The projects engaged the communities in meetings to introduce the projects and also during project implementation, worked with farmer groups and conducted field demonstrations through which they introduced farmers to different practices including the use of certified seeds, planting in lines, weeding at recommended times, fertilizer application at recommended times and rates among others. Technologies such as cubed fertilizers and biochar compost were introduced to the farmers.

Table 4.3 presents results of farmers' level of participation in the projects under study. The results reveal that overall, majority of the farmers (69.1%) participated fully in the activities of all the four projects. Similarly, across projects, most of the respondents participated fully with 65.1%, 52.7%, 89.6% and 83.3% being the levels of participation in ADVANCE, ATT, Sahel Grains and the USAID/UG FtF respectively. About a quarter of all surveyed farmers (24.2%) participated partially, while 6.7% of them showed low participation. Across projects partial participation ranged between 10% and 30%. Only farmers of ATT (13.2%) and ADVANCE (9.4%) had low participation.

Table 4. 3 Farmer level of participation across projects

		Overall (N=314)	ADVANCE (N=96)	Agricultural Technology Transfer (N=91)	Sahel Grains (N=67)	USAID/UG FtF (N=60)
Participation of Farmers	Low	**21 (6.7)**	9 (9.4)	12 (13.2)	0 (0)	0 (0)
	Partial	**76 (24.2)**	28 (29.2)	31 (34.1)	7 (10.4)	10 (16.7)
	Full	**217 (69.1)**	59 (61.4)	48 (52.7)	60 (89.6)	50 (83.3)

Source: Field Data (2020)

The components of participation in the project activities include participation in project implementation meetings, group meetings and social activities and field demonstration activities. The fact that majority of the farmers participated fully in the project activities implies that the farmers saw the project activities as relevant to their needs.

Farmer participation in agricultural capacity building is an important channel for improving their farm management practices to improving their livelihoods. Therefore, appropriate practices through new technologies introduced to farmers are expected to improve their farm productivity. The methods through which these technologies are introduced to the farmers play a major role in farmers' use of the technologies. For example, the bottom-up approach to agricultural development is now known to be a better alternative to the top-down approach when it comes to agricultural development. The top-down approach was said to be ineffective and unsustainable especially for beneficiary empowerment and development (Etwire et al., 2013). The bottom-up approach identifies beneficiaries as partners, utilize local knowledge and experiences and endeavour to empower target beneficiaries (Aref, 2011). Aref (2011) posits that without effective participation of farmers most agricultural development projects may fail especially in rural areas. Aref (2011) further explained that without participation there would not be partnerships, no development, and no programmes.

4.1.4 Influence of socio-economic characteristics on farmer participation in project activities

Table 4.4 shows the influence of socio-economic characteristics on farmer participation in the interventions. The Chi-square test result at 0.05 alpha level did not show any statistically significant association between sex, age groups and level of education and the levels of participation in the project activities (Table 4.6). However, the results show a statistically significant relationship between the regions ($\chi^2 = 47.423$, df = 8, p = 0.001) where the projects were undertaken and their level of participation. Similarly, there is a statistically significant relationship between marital status ($\chi^2 = 21.232$, df = 8, p = 0.007) and level of participation in the project activities. This finding corroborates findings by (Oladele & Olawuyi, 2011) who found a significant relationship between marital status and women participation in agricultural production.

Table 4. 4 Results of Chi-square analysis of socio-economic characteristics of respondents and levels of participation

Socio-economic variables		Low participation	Partial Participation	Full Participation	χ^2	df	Sig.
Region	Northern	13 (61.9)	16 (21.6)	31 (14.2)	47.423	8	0.001
	North East	1 (4.8)	16 (21.6)	33 (15.1)			
	Upper East	1 (4.8)	21 (28.4)	33 (15.1)			
	Upper West	0 (0)	10 (13.5)	41 (18.7)			
	Savannah	6 (28.6)	11 (14.9)	81 (37)			
Sex	Male	16 (76.2)	46 (62.2)	130 (59.4)	2.327	2	0.312
	Female	5 (23.8)	28 (37.8)	89 (40.6)			
Age group (years)	16 - 25 years	2 (9.5)	8 (10.8)	13 (5.9)	5.811	6	0.445
	26 - 35 years	6 (28.6)	20 (27)	42 (19.2)			
	36 - 45 years	6 (28.6)	19 (25.7)	64 (29.2)			
	Above 45 years	7 (33.3)	27 (36.5)	100 (45.7)			
Marital status	Married	19 (90.4)	58 (78.4)	187 (85.4)	21.232	8	0.007
	Divorced/Separated	1 (4.8)	11 (14.9)	19 (8.7)			
	Single	1 (4.8)	5 (6.8)	13 (5.9)			
Highest level of education	Tertiary	1 (10)	1 (4)	10 (13)	6.686	6	0.351
	Vocational	0 (0)	2 (8)	1 (1.3)			
	Senior High	2 (20)	8 (32)	29 (37.7)			
	Basic	7 (70)	14 (56)	37 (48.1)			

Source: Field data (2020)

Table 4.5 shows the influence of projects on farmer participation in the interventions. The results show a statistically significant difference in relationship between participation in three out of the four projects activities and their level of participation - for ATT, Sahel Grains and USAID/UG FtF Project - but not statistically significant for ADVANCE (Table 4.5). It implies that the farmers found the activities of the three projects more relevant to their needs than that of the ADVANCE project.

Table 4. 5 Results of Chi-square analysis of levels of participation across projects

Projects	Low participation	Partial Participation	Full Participation	χ^2	df	Sig.
ADVANCE	9 (42.9)	24 (33.33)	63 (28.51)	1.825	2	0.402
Agricultural Technology Transfer project (ATT)	12 (57.1)	31 (43.06)	48 (21.72)	19.394	2	0.001
Sahel Grains	0 (0)	7 (9.72)	60 (27.15)	16.708	2	0.001
USAID/UG FtF Project	0 (0)	10 (13.89)	50 (22.62)	8.423	2	0.015

Source: Field data (2020)

Farmers' participation is considered key for agricultural development projects such as those selected for the study which seeks to improve productivity in the communities aimed at poverty reduction (Maulu et al., 2021). In this study, respondents who did not participate fully mentioned lack of information on the timing of project activities, lack of time and ill health as reasons for not participating fully. This confirms some factors that serve as constraint to farmers' full participation in agricultural projects, which include lack of knowledge, confidence, time, and interest (Aref, 2011). During the focus group discussion some farmers indicated lack of information about project activities as the reason why they did not participate fully. Others indicated they were constrained by time because they had pressing issues to attend to.

4.1.5 Farmer Innovative performance (IP)

Table 4.6 presents the findings on the components of farmer IP across projects. The results revealed that most (98.7%) of the respondents acquired high knowledge. This was reflected at the project level, where respondents scored high in knowledge across all the projects, with ADVANCE, Sahel Grain and the USAID/UG FtF projects scoring 100% except ATT where 95.6% acquired high knowledge. It means that learning was effective across the projects. As farmers participate in capacity-building activities, they acquire knowledge, and this gives them competitive advantage over nonparticipating farmers. Similarly, knowledge is seen as a resource in the farm environment and therefore the more knowledge farmers acquire, utilize and share the better their farm performance (Jiang & Li, 2009).

The results also reveal that most of the respondents (93.3%) are fully practicing what they have learned. Also, across projects, most of the respondents indicated that they are practicing in full what they have learnt - ADVANCE (96%), ATT (95.6%), Sahel Grains (82.1%) and USAID/UG FtF (96.7%). It means the farmers find what they have learnt relevant for their production systems. If indeed farmers are practicing what they have learnt, then it is expected that there will be an improvement in their yields for the respective crops.

Table 4. 6 Components of Farmer Innovative performance (IP) across projects

		Overall (N=314)	ADVANCE (N=96)	Agricultural Technology Transfer project (N=91)	Sahel Grains (N=67)	USAID/UG FtF Project (N=60)
Knowledge acquired	Low	**1 (0.3)**	0 (0)	1 (1.1)	0 (0)	0 (0)
	Partial	**3 (1)**	0 (0)	3 (3.3)	0 (0)	0 (0)
	High	**310 (98.7)**	96 (100)	87 (95.6)	67 (100)	60 (100)
Practicing	Low	**5 (1.6)**	1 (1)	2 (2.2)	1 (1.5)	2 (3.3)
	Partial	**16 (5.1)**	3 (3.3)	2 (2.2)	11 (16.4)	0 (0)
	Fully	**293 (93.3)**	92 (96.0)	87 (95.6)	55 (82.1)	58 (96.7)
Sharing of Information						
Contributed to discussions and decision making related to the USAID Feed the Future project at your FBO or CBO meetings	Yes	**173 (55.1)**	52 (54.2)	42 (46.2)	37 (55.2)	48 (80)
	No	**100 (31.8)**	37 (38.5)	30 (33)	22 (32.8)	8 (13.3)
	Not sure	**41 (13.1)**	7 (7.3)	19 (20.9)	8 (11.9)	4 (6.7)
Talked to other people about knowledge or information acquired from participating in the USAID Feed the Future Project	Yes	**257 (81.8)**	86 (89.6)	70 (76.9)	56 (83.6)	50 (83.3)
	No	**21 (6.7)**	4 (4.17)	8 (8.8)	6 (9)	0 (0)
	Not sure	**36 (11.5)**	6 (6.3)	13 (14.3)	5 (7.5)	10 (16.7)
Made any contributions to local stakeholder platforms using inputs from the USAID Feed the Future Project	Yes	**51 (16.2)**	14 (14.9)	14 (15.4)	11 (16.4)	12 (20)
	No	**182 (58)**	57 (59.4)	52 (57.1)	41 (61.2)	29 (48.3)
	Not sure	**81 (25.8)**	25 (26)	25 (27.5)	15 (22.4)	19 (31.7)
Experimenting	Yes	**225 (71.7)**	70 (72.9)	64 (70.3)	48 (71.6)	45 (75)
	No	**89 (28.3)**	26 (27.1)	27 (29.7)	19 (28.4)	15 (25)
Attracting resources to aid community	Yes	**79 (25.2)**	28 (29.2)	13 (14.3)	12 (17.9)	28 (46.7)
	No	**235 (74.8)**	68 (70.8)	78 (85.7)	55 (82.1)	32 (53.3)
Making resources available to the community	Yes	**77 (24.5)**	26 (27.1)	14 (15.4)	11 (16.4)	27 (45)
	No	**237 (75.5)**	70 (72.9)	77 (84.6)	56 (83.6)	33 (55)

Source: Field Data (2020). Note: values in brackets are in percentages

Most capacity-building projects are unable to train as many farmers as they ought to due to financial constraints. In recent times, one major problem that saddles MoFA is the poor Extension to Farmer ratio which stood at 1:5851 as compared to FAO standard of 1:500 (MOFA, 2018). This makes it practically impossible for information on new technologies to get to the majority of the farmers who need the information to improve their productivity. In this study farmer-to-farmer information sharing (Lukuyu et al., 2012; Ssemakula & Mutimba, 2011) is a key component in the construct of farmer innovative performance. Ssemakula and Mutimba (2011) indicated that farmer-to-farmer extension is based on the tenets of social learning where individuals meet to discuss their challenges and through mutual actions find solutions to the challenges (Forsyth, 2006:25).

The PCA analysis revealed that information sharing, and utilization contributed most to the construct of innovative performance. This finding corroborates a study by Jokisaari and Vuori (2014) that indicate that information sharing is an important aspect of socialisation and may improve innovative performance. This is because during information sharing the one giving the information is also a recipient of some information and therefore information sharing becomes a two-way affair. Similarly, Jantunem (2005) found that the flow of knowledge is key in sustaining innovative performance rather than the store of knowledge. Juntunem further indicated that the results of regression analysis in their study showed that knowledge utilisation capabilities were reflected in the firms IP while knowledge was only recognised as a potential source for comparative advantage. The above give credence to the importance of information sharing as key to the construct of innovative performance and not knowledge alone. On the contrary studies have shown that knowledge is very important and forms the core of innovation (Läpple et al., 2015).

Similarly a study by Chindime et al. (2017) revealed that access to knowledge is a significant component of innovation index in smallholder dairy farming in Malawi. This contradicts the findings of this study which renders knowledge redundant in the construct of farmer innovative performance.

In terms of information sharing, respondents' contribution to discussions and decision making at community meetings, talking to other people about the project and contributing to local platforms were explored. In terms of respondents' contribution to discussions and decision making related to the FtF projects at their FBO or community meetings, majority (55.1%) of the respondents across the various projects indicated they do express their views during discussions and decision making. Such contributions included:

- Encouraging colleague farmers to take knowledge acquired seriously so they get good yield (using certified seeds, soil fertility management, use of compost in place of inorganic fertilizer etc.)
- The need to manage a farm size that one is comfortable with and not necessarily expand crop land for the sake of it
- Sharing information about experiences and the benefit of the projects during meetings

- Telling other projects about our group and how we manage ourselves to get a tractor for the group
- How to manage and make FBOs successful
- Help in making decisions at meetings
- Explaining activities about a technology to those who do not understand or have difficulty in understanding the methods
- Encouraging farmers to join a group
- Encouraging colleague farmers to teach other farmers in their communities
- Timely distribution of inputs (seeds and fertilizers)
- Encouraging donors to help with fertilizers
- The need to keep farm records
- Working hard to attract more projects

Overall, most of the farmers (81.8%) have spoken to other people (friends, relatives, and other farmers) about the knowledge acquired. A similar observation was made across the projects where most respondents indicated they have spoken to other people about the knowledge and skills they have acquired. During the focus group discussion, the farmers indicated that they talk to each other about their farm management practices which confirms the results obtained. The kind of information the respondents shared as a result of participating in the project, with relatives, friends, and other farmers are as follow:

- Applying the knowledge acquired on vegetables and other crops like groundnuts, sorghum, vegetables, and cowpea and livestock, apart from crops introduced to them
- Application of compost to get a good yield

- Soliciting financial assistance from the financial services
- Forming a group and offering services to other farmers
- Keeping records of all farming activities
- Increasing farm size because of knowledge acquired

The study has revealed that information sharing is key in the innovative performance of farmers and there it is crucial that as much as possible farmers who participate in agricultural interventions must share the information to improve on the innovativeness of farmers (Lukuyu et al., 2012; Ssemakula & Mutimba, 2011; Jokisaari & Vuori ,2014).

About whether they make contributions to local platforms using inputs from the projects, on the contrary, only a few respondents (16.2%) indicated they have contributed to local platforms and the majority of them did not make such contributions. This was observed across the projects as well. The types of local platforms include:

- Community local group
- Farmer groups
- Community local stakeholder platform
- Rice farmers association
- Town development committee
- The village, savings, and loans group
- Women groups

The contributions made to the local platforms as a result of participating in the project include:

- The need to take farming seriously and to put the knowledge acquired (keeping farm records, planting early, proper fertilizer application etc.) into practice
- Facilitating processes for farmers to get inputs on time
- Making water available for everyone to use
- Enforcing group decisions
- Sharing the knowledge acquired from the project (effectiveness of planters, certified improved seeds
- How to help the community
- Training other farmers on how to make compost
- Effectiveness of record-keeping
- Making financial contributions

Overall, 71.7% indicated they are conducting experiments using the knowledge acquired. Across the projects a similar observation was made where majority of the respondents are experimenting. Some of the farmers tried the knowledge on the cultivation of other crops such as vegetables (pepper, onions, and tomatoes), groundnut, and sorghum which were not part of the crops targeted for the technologies introduced by the projects. A farmer in Lawra applied biochar compost on pepper and had very good yields (Plate 4.1).

Plate 4. 1 Pepper planted with biochar compost in Lawra

During the focus group discussion, the farmers indicated that experimenting meant trying out what they have learned from the project on their farms, practicing and seeing the effectiveness of what was learned and trying what they have learned on a small scale (plots) before transferring on to the main farm. This implies that the farmers may not be trying the technologies introduced to them directly on their farms yet. This may affect yields negatively.

Farmers' experiments aim at trying the efficacy of new innovations before applying them fully in their fields. By experimenting farmers try these innovations on small plots and produce outputs, such as new products (Gunawan et al., 2016). On these plots, farmers conduct activities, such as trials for new varieties, new farm inputs (e.g., pesticides or fertilizers), or new technologies such as the use of biochar compost in the cultivation of crops.

In Lawra, although the farmers were introduced to biochar compost in the cultivation of soybeans, a farmer, Mr. Asibi Bawa applied biochar compost on his dry season onion farm and had very good harvest. Although the onions were planted at the same time on both the treatment and control plots, in the picture, the treatment (biochar compost) applied plots had several onion bulbs formed and the plants looked bigger and healthier compared to the non-biochar plot. Mr. Bawa made very good sales from his harvest and intends producing organic onions for the Royal Cosy Hills Hotel nicknamed "Jirapah Dubai" by the locals in Jirapah.

a b c

Plate 4. 2 A gallery of (a) Non-biochar onion plot (b) Mr. Asibi Bawa with harvested onions and (c) Biochar compost plot onions

Farmer experimentation which was considered in the construct of IP is corroborated by Álvarez-Coque et al. (2018) who suggested that experimentation and learning are part of innovation. A study by Leitgeb et al (2011) revealed that farmer experimentation with the knowledge they acquire serve as a source of information for further research by scientists and contribute to national agricultural systems. Farmers may be more confident to share information if they experiment with the knowledge and see the effect which most often than not is expected to be positive. Therefore, farmer experimentation is key in their innovative performance as observed by (Álvarez-Coque et al. 2018).

During and after projects, farmers are exposed and come into contact with different stakeholders and interact with them at various levels including collaborations and partnerships. Such partnerships foster trust and helps build relationships amongst the stakeholders or actors (tenets of social learning). Through such relationships, farmers request help from such stakeholders and attract resources which they use to help themselves and the community members. Respondents were therefore asked if they were attracting resources to aid the community. About 25.5% of the respondents indicated they are attracting resources to aid the communities. These are mainly done by contacting organisations to support their farming activities which come in the form of donations of tricycles, rice shellers, and planters by the funding agencies to the farmer groups. The groups take ownership of the equipment and decide how to use them. The use of these equipment reflect consensus building and group action. The equipment goes a long way to help the farmers and other community members in their farm operations to improve productivity. Scenarios were given where people have been carried to hospitals in tricycles that were donated to farmer groups. Tricycles have also been used to carry farm produce for community members at small fees and sometimes free of charge.

In a FGD at Wulugu in West Mamprusi, a male farmer indicated that

> We wrote a proposal to Korea International Cooperation Agency (KOICA) on how our FBO, Wulugu Laamgbai group, was going to move forward after the USAID/UF FtF project and we won the competition. At the interview in discussing our group activities, we mentioned the fact that we are working with USAID/UG FtF project in the use of biochar compost to produce rice and this gave us the advantage to win a rice mill (Plate 4.3) as the ultimate price from the competition. We emphasized the fact that USAID will only work with a group that is in good standing and that made us successful. Other farmers from other groups through engagements with funders have been given tractors and other implements to aid

farming in their groups and community at large (A male farmer in Wulugu, 20th October 2020).

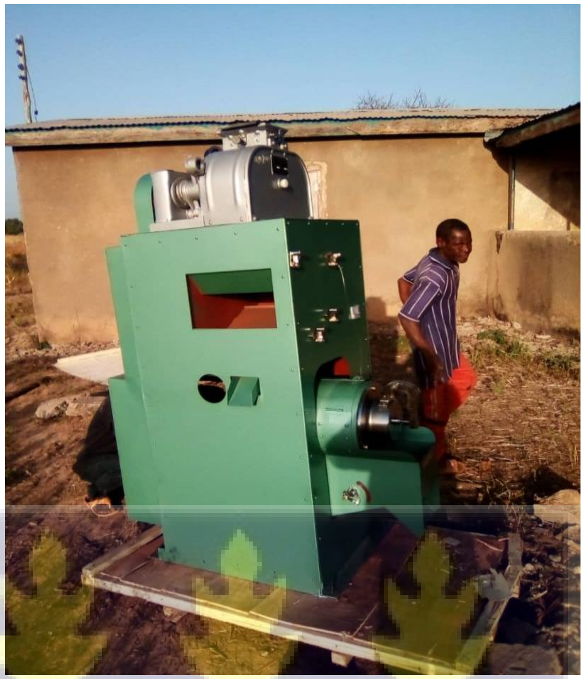

Plate 4. 3 Rice mill won by a farmer group in West Mamprusi

Similarly, overall few respondents 24.5% are making resources available to aid the community. As mentioned earlier tricycles donated to FBOs are used in carrying farm produce for community members. This implies that as more and more support come to the FBOs the communities stand the chance of benefitting.

Dolinska and d'Aquino (2016) posit that farmer participation in the implementation of interventions involving group activities and processes empowers them to innovate and they learn through such active interactions. Invariably, agricultural productivity improvement will hinge on innovations at both institutional and farmer levels (Läpple et al., 2015).

Table 4.7 sheds light on the IP status of respondents across projects. The results revealed that overall, the majority of the respondents (46%) exhibited High IP, while a few (31%) exhibited low IP. Most respondents of the ADVANCE, ATT and Sahel Grains projects exhibited high IP, 44.8%, 49.5% and 56.7% respectively, compared to the USAID/UG FtF project where the majority (53.3%) of the respondents exhibited low IP compared to the 31.7% who exhibited high IP. The reason may be because the ADVANCE, ATT and Sahel projects have been completed and therefore the farmers are getting full benefit of their projects hence are able to utilize and share information about their projects, unlike the USAID/UG FtF Project which was ongoing at the time of collecting the data. It may also be because the three projects provided other services including tractor services (ADVANCE and Sahel grains), provision of inputs such as fertilizers as was the case with the ATT project.

Table 4. 7 Overall IP status of respondents across projects

		Overall (N=(314)	**ADVANCE (N=96)**	**Agricultural Technology Transfer project (N=91)**	**Sahel Grains (N=67)**	**USAID/UG FtF Project (N=60)**
IP Status	Low IP	**96 (31)**	27 (28.13)	23 (25.3)	14 (20.9)	32 (53.3)
	Medium IP	**73 (23)**	26 (27.1)	23 (25.3)	15 (22.4)	9 (15)
	High IP	**146 (46)**	43 (44.80)	45 (49.5)	38 (56.7)	19 (31.7)

Source: Field Data (2020)

A Chi-square test result at 0.05 alpha level shows statistically significant relation between the USAID/UG FtF project and IP (χ^2 = 18.737, df = 4, p = 0.001). However, there is no statistically significant relationship between ADVANCE, ATT and Sahel Grains and IP (Table 4.8). The results corroborate studies by Xayavong et al. (2016) and Molina et al.

(2021) that indicated that farmer participation in trainings and utilization of innovations had significant beneficial impact on farm performance. This implies that the USAID/UG FtF project had influence on the participants IP (utilizing and sharing information about the knowledge acquired) while the other three projects did not have any influence.

Table 4. 8 Chi Square analysis of IP across projects

Projects	IP Status			χ^2	df	Sig.
	Low IP	Medium IP	High IP			
ADVANCE	32 (30.2)	26 (24.5)	48 (45.3)	0.164	2	0.921
Agricultural Technology Transfer project (ATT)	23 (25.3)	23 (25.3)	45 (49.5)	1.517	2	0.468
Sahel Grains	14 (20.9)	15 (22.4)	38 (56.7)	4.406	2	0.110
USAID/UG FtF Project	32 (53.3)	9 (15.0)	19 (31.7)	18.737	2	0.001

Source: Field Data (2020)

4.1.6 Influence of socio-economic characteristics on farmer innovative performance

Table 4.9 shows the influence of socio-economic characteristics on farmer innovative performance. The Chi-square test result at 0.05 alpha level did not show any statistically significant relationship between age group, marital status and highest level of education and the levels of IP (Table 4.9). However, the results show a statistically significant association between the regions where the projects were undertaken on their innovative performance (Table 4.9). Since IP has to do with knowledge utilization and information sharing, it means in certain regions more people are using and sharing information while in other regions people are not utilizing and sharing information. It also implies that in the conflict prone locations such as Bawku, it may not be totally possible to share information. Also, farmers may not be able to utilize the knowledge acquired as they should which may affect IP. This is because conflict affects farmers' utilization of technologies which ultimately affect their ability to produce (Adzenga et al., 2019; Chikaire et al., 2016). The results also show a statistically significant association between sex and their innovative performance. The results corroborate studies by Idemudia et al. (2017) and Liu (2010) who found differences in the priorities of males and females in terms of information sharing. On the contrary Plume and Slade (2018) found no significant difference between males and females' motivations in information sharing. However, Tannenbaum et al. (2016) emphasized the need to consider gender in research implementation since it may be an important determinant of knowledge use and research effectiveness.

Table 4. 9 The results of Chi-square analysis of socio-economic characteristics of respondents and Innovative performance

		Innovative Performance			Test of Association		
Socio-economic variables		Low IP	Medium IP	High IP	χ^2	df	Sig.
Region	Northern	26 (27.4)	12 (16.4)	22 (15.1)	43.488	8	0.001
	North East	17 (17.9)	8 (11)	25 (17.1)			
	Upper East	20 (21.1)	10 (13.7)	25 (17.1)			
	Upper West	25 (26.3)	7 (9.6)	19 (13)			
	Savannah	7 (7.4)	36 (49.3)	55 (37.7)			
Sex	Male	71 (74.7)	41 (56.2)	80 (54.8)	10.628	2	0.005
	Female	24 (25.3)	32 (43.8)	66 (45.2)			
Age group (years)	16 - 25 years	4 (4.2)	8 (11)	11 (7.5)	9.85	6	0.131
	26 - 35 years	26 (27.4)	19 (26)	23 (15.8)			
	36 - 45 years	23 (24.2)	17 (23.3)	49 (33.6)			
	Above 45 years	42 (44.2)	29 (39.7)	63 (43.2)			
Marital status	Married	87 (91.6)	56 (76.7)	121 (82.9)	11.528	8	0.174
	Divorced	0 (0)	1 (1.4)	0 (0)			
	Widowed	4 (4.2)	9 (12.3)	16 (11)			
	Single	4 (4.2)	7 (9.6)	8 (5.5)			
	Separated	0 (0)	0 (0)	1 (0.7)			
Highest Level of education	Tertiary	4 (9.3)	2 (8.7)	6 (13)	1.993	6	0.92
	Vocational	2 (4.7)	0 (0)	1 (2.2)			
	Senior High	16 (37.2)	8 (34.8)	15 (32.6)			
	Basic	21 (48.8)	13 (56.5)	24 (52.2)			

Source: Field Data (2020)

A study by Moreno et al. (2018) concluded that gender determines the effect of information sharing and its influence on organizational performance. It means when it comes to utilization and sharing of information gender has a role to play.

4.1.7 Influence of farmer participation on their innovative performance

The Chi-square test result at 0.05 alpha level show statistically significant relationship in the levels of participation and IP (χ^2 = 11.254, df = 4, p = 0.024). The results (Table 4.10) indicate that at all levels of farmer participation, the majority of the farmers exhibited high level of IP. Those who participated fully exhibited high IP while those who participated partially obtained medium IP and those with low participation had low IP. The results corroborates findings by Tambo and Wünscher (2018) and Molina et al. (2021) which showed that farmers' participation in agricultural projects strengthens their innovation performance. It means that when farmers participate in project activities they are introduced to innovations and when it turns out well, they may acquire the knowledge, be excited and therefore will discuss, try it out and share information about what they are observing. This will happen when farmers participate fully in the activities and see the full benefits of the innovations. In cases where farmers do not participate fully, knowledge acquisition and its utilization may be a challenge hence the results being observed between farmers who participated fully, and their IP status as compared to those who did not participate fully. This finding corroborates findings by Chindime et al (2017) that showed that farmers participation in capacity building helped in the acquisition of requisite knowledge and skills that enable them to improve their productivity.

Table 4. 10 Cross-tabulation of farmer participation and IP

		IP Status			Pearson Chi-Square Test		
		Low IP	**Medium IP**	**High IP**	χ^2	**df**	**Sig.**
Participation of Farmers	Low participation	3 (3.2)	8 (11)	10 (6.8)	11.254	4	0.024
	Partial Participation	24 (25.3)	24 (32.9)	26 (17.8)			
	Full Participation	68 (71.6)	41 (56.2)	110 (75.3)			

Source: Field Data (2020)

In this thesis social capital is reflected in group activities of the project where social learning has a role to play in building trust and friendship among participants thereby enhancing social capital (Bhandari & Yasunobu, 2009). During the focus group discussion in Lawra, the farmers indicated that participating in the project has helped the group members to build trust and friendship among themselves and therefore they always try to help each other where group members face challenges. They further explained that "we are not happy when any group member faces difficulties and therefore it is only when all our members are doing fine that we also feel happy. For example, when a group member is sick, we contribute to take care of the person till recovery".

4.1.8 Section Summary

In summary, the chapter has examined the levels of participation of respondents in the various project activities involving project implementation, group activities and field demonstration. The overall majority of the farmers participated fully in the project activities. Similarly, across projects, most of the respondents participated fully in the project activities. The PCA analysis extracted mainly information sharing and utilization as contributing most to the construct of innovative performance. The majority of the respondents exhibited high IP, while a few exhibited low IP. The Chi-square test result shows a statistically significant difference in the levels of participation and IP. The results indicate that at all levels of farmer participation majority of the farmers exhibited a high level of IP. Those who participated fully had high IP while those who participated partially obtained medium IP and those with low participation had low IP.

4.2 THE RELATIONSHIP BETWEEN SMALLHOLDER FARMER INNOVATIVE PERFORMANCE AND CROP PRODUCTIVITY

4.2.1 Introduction

This chapter presents findings on the relationship between smallholder farmers' innovative performance after participation in the USAID/UG FtF capacity-building project activities and their yields (kg/ha) concerning the selected FtF crops. The chapter begins by presenting and discussing the effects of the projects on the yields (kg/ha) of their respective participants before and after participating in the project activities. It further examines the relationship between innovative performance and the yields (kg/ha) obtained by the project participants.

4.2.2 Capacity Building effect on crop productivity (before and after the project intervention)

Low crop yields in northern Ghana over the years is attributed to continuous cropping of the land coupled with other factors such as poor soil fertility, mono rainfall pattern, and rudimentary cultural practices. Therefore, crop yields have consistently been below what is attainable national averages (Wood, 2013; Kermah et al, 2018). Constant innovation has been prescribed as a precedent for growth in the agricultural sector (Zizlavsky, 2016). Therefore, for interventions such as the USAID FtF capacity building projects which seek to improve the yields of the farmers, the farmers need to be innovative to improve their yields and livelihoods.

Figure 4.1 presents maize yields (kg/ha) before and after capacity building. There is evidence to support the fact that yields of maize improved after the capacity building. Based on the Wilcoxon sign ranked test there is a statistically significant difference at 1% in yield before and after for maize with respect to each capacity building intervention - ADVANCE, ATT, Sahel Grains, USAID/UG FtF Project (Fig 4.1). For example, the overall/aggregated yield data for all four projects revealed that before the capacity building, maize yield was 1730 kg/ha and after the project maize yields significantly increased to 2471.05 kg/ha. The yields of ADVANCE participants mimicked the overall/aggregated yield of maize (1730 kg/ha) before the capacity building, while ATT and the USAID/UG FtF projects' participants recorded the least maize yields (1483kg/ha). However, compared to USAID/UG FtF, participants of the ATT project recorded higher yields (2965.26 kg/ha) after the intervention. Sahel Grains participants had the highest before yields (2471 kg/ha) and after yields (3336 kg/ha) (Fig 4.1). The reason is that Sahel Grains targeted maize growing areas in northern Ghana for their intervention and that explains the relatively higher yields before and after the capacity building. They also supported farmers with planters and tractor services as well as post-harvest services and this might have had a positive impact on their maize yields.

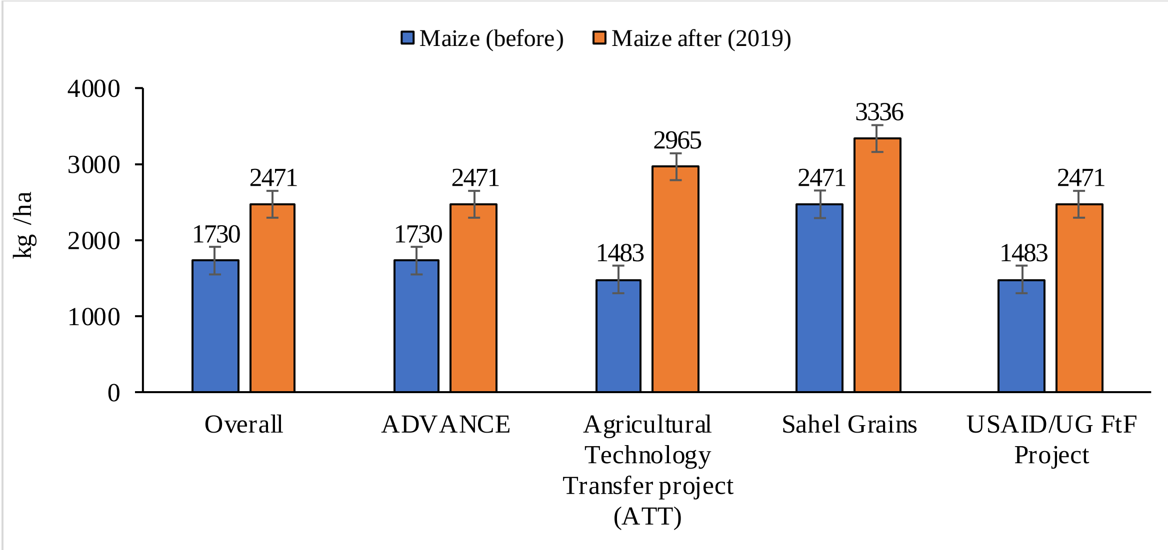

Fig. 4. 1 Maize yields (kg/ha) before and after project implementation

Source: Field Data (2020)

Fig 4.2 presents rice yields (kg/ha) before and after capacity building. There is evidence to support the fact that yields of rice improved after the capacity building. The results of the Wilcoxon sign ranked test indicate a statistically significant difference in the yields at 1% level of significance before and after the capacity building interventions for rice with respect to ADVANCE (z=-4.604, p = 0.001), ATT (z=-5.729, p = 0.001), USAID/UG FtF Project (z=-4.515, p = 0.001) except Sahel Grains (z=-1.732, p = 0.083) which was not significant even at 5% level of significance. The overall yield data for rice indicate that before the capacity building rice yield was 1235.53 kg/ha, however after the capacity building interventions the yield of rice increased to 2471.05 kg/ha, twice the yield before capacity building. Participants of the ATT project recorded the highest rice yield (3459.47 kg/ha) after the capacity building. In the case of the USAID/UG FtF project, participants recorded the least yield (741.32 kg/ha) before the capacity building compared to the other projects. Similarly, in relative terms, the USAID/UG FtF project recorded the least yields (1482.63 kg/ha) after the capacity building, although yields doubled. The yields obtained by project participants of ATT and Sahel Grains were above the current national average yield of 2.92 mt/ha an equivalent of (2945.1 kg/ha) National Development Planning Commission (NDPC, 2017) while that of ADVANCE and the USAID/UG FtF projects were below the current national average. The USAID/UG FtF project was still under implementation at the time of the investigation and the farmers on their own decided to try the technology (biochar compost) on their farms hence the low yields recorded. At the time, no recommendation had been made to the farmers as to the application rate of the biochar compost. Like maize, the results revealed that various project implementation led to increased rice productivity.

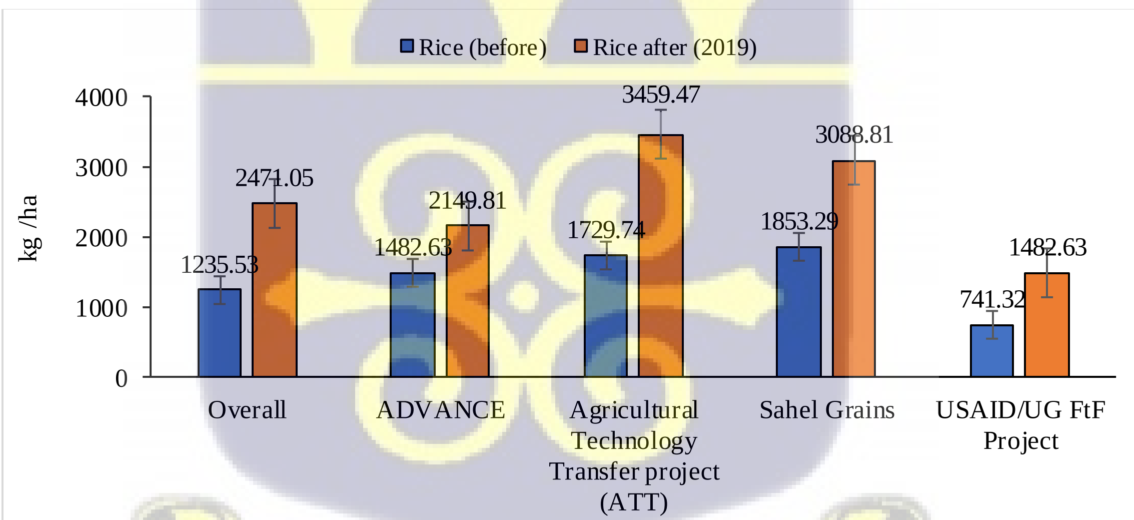

Fig. 4. 2 Rice yields (kg/ha) before and after project implementation

Source: Field Data (2020)

Figure 4.3 presents soybeans yields (kg/ha) before and after capacity building. The story was not different for soybean. There is evidence to support the fact that yields of soybeans improved after the capacity building. The results indicate that implementation of the four projects led to increased yields of soybeans. There is statistically significant difference between the yields at 5% level of significance before and after capacity building: ADVANCE (z=-6.016, p = 0.001), ATT (z=--5.547, p = 0.001), Sahel Grains (z=-4.05, p = 0.001), USAID/UG FtF Project (z=-3.654, p = 0.001). The overall/aggregated yield for soybeans revealed that before the project soybean yield was 790.74 kg/ha but this increased to 1235.53 kg/ha after the capacity building. Participants of the ATT project recorded the highest soybeans yields after the capacity building. Before the capacity building ATT participants had the second highest soybean yields of 988.42 kg/ha above the overall yield of 790.74 kg/ha while they had the highest yield of 1976.84 kg/ha after the capacity building, which is higher than the current national average of 1.65 mt/ha about 1664.18 kg/ha, which was also higher than the overall/aggregated post project yield (1235.53 kg/ha) (Fig 4.3). Again, participants of the USAID/UG FtF Project yields were low for both before and the after- capacity building. This was because the farmers were trying the technology on their own without the requisite recommendation for application of the technology as was explained earlier.

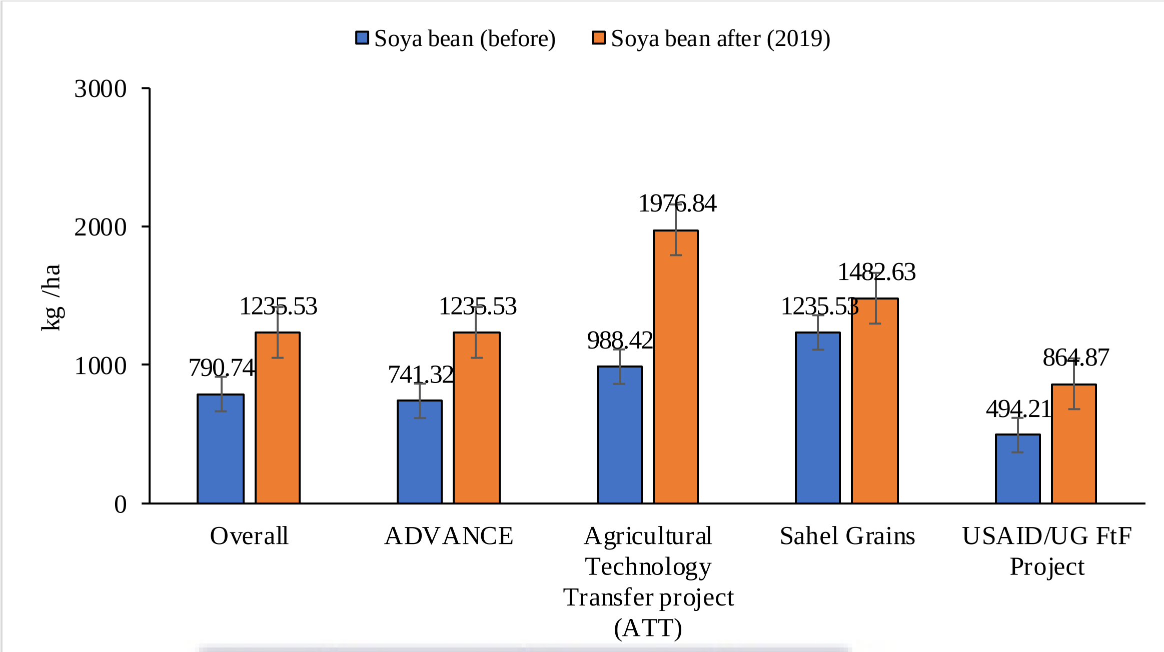

Fig. 4. 3 Soybeans yields (kg/ha) before and after project implementation

Source: Field Data (2020)

The results indicate that for all the three crops, yields improved after capacity building. It implies that farmer participation in the projects has influenced their yields positively. This result corroborates a study by Danso-Abbeam et al. (2018) that revealed that when farmers participate in capacity building their yields improve.

4.2.3 Influence of Farmer Innovative Performance on yield of the selected crops

Capacity building enhances farmers knowledge and skills which is expected to help them improve on their farm performance. It is therefore expected that farmers will utilize the knowledge and skills acquired to improve their yields.

Table 4.11 presents results on IP against yields of maize, rice, and soybeans (kg/ha) before and after capacity building. From the results generally, there is an improvement in the yields of all the crops irrespective of the innovative performance of the farmers. The results show a statistically significant difference in maize yield before and after the capacity building with respect to IP at 5 % level of significance (Table 4.11). Those with low and high IP had better maize yields than those with medium IP. In the case of maize, participants with low IP had higher yields before (1977 kg/ha) and after (2965.26 kg/ha) the capacity building. This was followed by participants with high IP who attained yields of 1730 kg/ha before the project and 2718.16 kg/ha after the project. Those with medium IP recorded the least yields (2471.05 kg/ha) after the capacity building. This results is contrary to suggestion by Lee and Trimi (2018) that the application of innovation makes life better for individuals and the society at large. They emphasised the fact that innovations must be applied in smart ways to reap its benefits. Robertson et al. (2021) also indicated that knowledge creation and diffusion are necessary for innovation performance that affect stakeholders positively. It is when yields are high that farmers derive enough produce to sell and derive more income to use to meet their needs. The results imply that farmers are not innovating enough to improve their yields to meet potential yields which is key in addressing poverty in northern Ghana. It is likely that farmers are trying the technologies on small plots rather than full scale application in their fields as observed by (Hagedoom & Cloodt, 2003). They may also not be applying the technologies correctly as they indicated.

Table 4. 11 IP against maize yields (kg/acre) before and after project interventions

IP Status	Crops	Median Yield (kg/hectare)	Wilcoxon Signed Ranks Test (z)	p-value
Low IP	Maize (before)	1977.00	-6.639	0.001
	Maize (2019)	2965.26		
	Rice (before)	1235.53	-5.046	0.001
	Rice (2019)	2471.05		
	Soya bean (before)	741.32	-3.455	0.011
	Soya bean (2019)	1235.53		
Medium IP	Maize (before)	1359.50	-7.015	0.001
	Maize (2019)	2471.05		
	Rice (before)	1606.18	-3.942	0.001
	Rice (2019)	2471.05		
	Soya bean (before)	741.32	-5.777	0.001
	Soya bean (2019)	1359.08		
High IP	Maize (before)	1730.00	-9.664	0.001
	Maize (2019)	2718.16		
	Rice (before)	1235.53	-6.892	0.001
	Rice (2019)	2075.68		
	Soya bean (before)	988.42	-7.166	0.001
	Soya bean (2019)	1284.95		

Source: Field Data (2020)

Similarly, in the case of rice, there is statistically significant difference in yield before and after project intervention with respect to IP at 1% level of significance. Participants with low IP and medium IP had higher yields (2471.05 kg/ha) after the project intervention compared to participants with high IP who obtained the least average yield of 2075.69 kg/ha after the project intervention. Those with medium IP recorded the highest average yield (1606.18 kg/ha) before the project implementation while those with low and high IP had the least yields of 1235.53 kg/ha (Table 4.11).

The results reveal a statistically significant difference in soybean yield with respect to IP at 1% significance level. Participants with low and medium IP had the least yields (741.32 kg/ha) before the capacity building while those with high IP had the highest yields (988 kg/ha) before the capacity building. Those with medium IP had the highest yields (1359.08 kg/ha) after the capacity building followed by those with high IP with yield of 1284.95 kg/ha (Table 4.11).

Generally, those with high IP have not performed as expected which suggest that IP had no influence on yield. These findings contradict suggestion by Lapple et al. (2015) that farmers with high innovative performance have higher farm incomes due to high productivity. In a study to investigate the impact of innovation on economic sustainability focusing on profitability, productivity of land and market orientation Läpple and Thorne (2019) found out that given a certain level of innovation, a relatively small level of improvements to innovation can lead to significant economic gains. They also found out that innovative farmers can achieve further economic gains by innovating further. Nakano et al. (2018) also observed that technology adoption rate, productivity and profitability of trained farmers rose immediately after capacity building which resulted in a wide yield gap compared to untrained farmers.

It implies that when farmers fall short of utilizing knowledge and skills acquired through capacity building, for example not applying the technology properly this will affect their yields. From the results it is possible that farmers may not be applying the technologies correctly or may be going back to their old ways of farming practices for various reasons which may include:

- Non availability of the technology inputs e.g., fertilizers, biochar compost etc.

- The farmers cannot afford the technologies
- They are still experimenting with the technologies on small plots before transferring to their main farms (Etriya et al., 2019).

Plate 4.4 is a picture taken during field observation on a project participant's farm in Bawku. Although the farmers were trained to dibble and apply the fertilizer, this farmer went ahead with the old practice. The farmer did not plant in rows as well. This will obviously affect the yield of this farmer.

Yields could also be influenced by other factors other than IP. This is an affirmation of the findings of a study by Kermah et al. (2018) that there are so many factors that affect the yields of crops including, rainfall pattern, soil fertility as well as cultural practice. The fact that IP is not having a desirable effect on yield may indicate that farmers are not utilizing and sharing information on the knowledge and skills acquired. The results may also be linked to non-availability of resources especially fertilizer for production purposes.

Plate 4. 4 Wrong application of fertilizer by a farmer in Bawku

When farmers share information, they are likely to also acquire complex knowledge from others during the information exchange (Jakisaari & Vuori, 2014). Confronting their peers and sharing their experiences are said to be crucial especially for farmers engaging in innovative activities (Boettiger et al., 2017; Robbins-Thompson, 2019). The whole idea is to empower farmers as agents of change.

Another key factor identified is armed conflicts which prevent farmers from producing (Jakisaari & Vuori, 2014). Trust and cooperation create the environment through which valuable knowledge is exchanged (Ali et al., 2019). This will stimulate relationship building and prevent situations where community members cannot benefit from productivity enhancing technologies.

Information sharing is also based on trust and therefore when there are conflicts there will be mistrust which will not enhance information sharing at the community level. For example, in Bawku, one of the Municipals where most of the selected capacity building projects are being implemented is conflict prone. In the USAID/UG FtF project, due to the conflict in Bawku some communities were not willing to work with other communities. A compost platform to be constructed in a community to be used as a learning centre had to be constructed at the Department of Agriculture in Bawku to forestall any anticipated challenges due to the conflict. That was how the project got the communities to work together and learn how to prepare biochar compost for use in cultivating maize. Through effective facilitation of the learning processes, demonstration farms were set up in the communities where community members could visit other communities to participate in field demonstration activities from planting to harvesting. The Director of Agriculture in Bawku had this to say, "for the first time in so many years we have faction communities coming together to work on a project" (C. Akwotiga, personal communication, July 20, 2020). Obviously, conflict and mistrust may not enhance farmer innovative performance to improve yields because valuable information cannot be shared and utilized in the communities. In the case of Bawku there where challenges for the USAID/UG FtF Project because participants in some communities were not willing to work with each other due to conflict.

In terms of farmer practices, it is possible that farmers did not apply the inputs on time, which may not translate into higher yields. It is also possible that farmers go back to their old ways of farming or do not implement the full practices they were taught, and this could affect their yields. During the focus group discussion, the farmers indicated that:

> Initially when we started practicing what we were taught, we had all the inputs we needed so we had very good yields, however with time we were not getting the inputs and that has caused our yields to decline (A male farmer in West Mamprusi, 19th July 2020).

This implies that introducing farmers to a technology is not the end but ensuring the technology is sustained is of optimum importance.

Farmers' innovativeness is said to drive their performance to improve yields (Chindime et al., 2017). Clearly when farmers practice what they have learnt and experiment with it they will be more confident in the technologies introduced. With that confidence they should be able to share their experiences with community members and use their associations to request for help from institutions and organisations to aid their communities. It is possible that the farmers may be trying out the technologies on smaller plots before rolling it out on a full scale on their farms as observed by Etriya et al. (2019). If agriculture is to advance effort in reducing poverty in northern Ghana, then the famers must innovate to increase their yields.

4.2.4 Section Summary

In summary, the chapter has examined the relationship between farmer innovative performance and yields. The results indicate that generally there is increase in yields before and after the project interventions. There is a statistically significant difference in the yields of the crops before and after participation in the project activities. Similarly, there is a statistically significant relationship between innovative performance and crop yield. However, the increases in yield did not depend on farmer IP. Farmers with low IP had higher yields for maize and rice compared to those with medium and high IP. It may imply that farmers may be applying their old practices and may be experimenting with what they have learnt on small plots and therefore are yet to start practicing fully, what they have learnt on their farms.

4.3 THE RELATIONSHIP BETWEEN SMALLHOLDER CROP PRODUCTIVITY AND POVERTY REDUCTION

4.3.1 Introduction

This subsection presents results and findings of the relationships between farmer yield and their income, food security, and well-being. The subsection begins by presenting and discussing the yields (kg/ha) of the three crops namely, maize, rice, and soybean before and after the FtF capacity-building projects in the zone of influence. This is followed by results and discussions on the income before and after the project intervention and the relationship between crop productivity and income. The subsection ends with some concluding remarks.

4.3.2 Relationship between crop productivity and income of the respondents

This subsection presents the results and discussion of the relationship between crop productivity and income of the respondents.

4.3.2.1 Comparison of crop yield (kg/ha) before and after project intervention

Figure 4.4 presents results of crop yields (kg/ha) before and after the capacity building. There is evidence to show that there is improvement in yield after the capacity-building interventions. The results of the Wilcoxon sign rank test show a statistically significant difference in yield at 1% level of significance between the yields before and after capacity building of the three crops: maize, rice, and soybean (Fig 4.4). The farmers are getting higher yields after participating in the capacity building compared to yields before participation in the capacity building. The yield of rice doubled from 1235.53 kg/ha to

2478.05 kg/ha. Similarly, the yields of soybean after the capacity building increased from 790.74 kg/ha to 1235.53 kg/ha. The results give an indication that farmer participation in the various capacity building improved their yields. This result corroborates the results of a study by Mozumdar (2012) which showed that when farmers participate in technology interventions their yields improve significantly. However, they emphasized it takes time to realise the full benefits of the intervention. According to (Chavas & Cox, 1992, as cited in Mozumdar, 2012) it takes about a 15-year lag between the time of investment in research and the effect on productivity. That notwithstanding, within this short period the farmers are increasing their yields after participating in the FtF capacity building interventions.

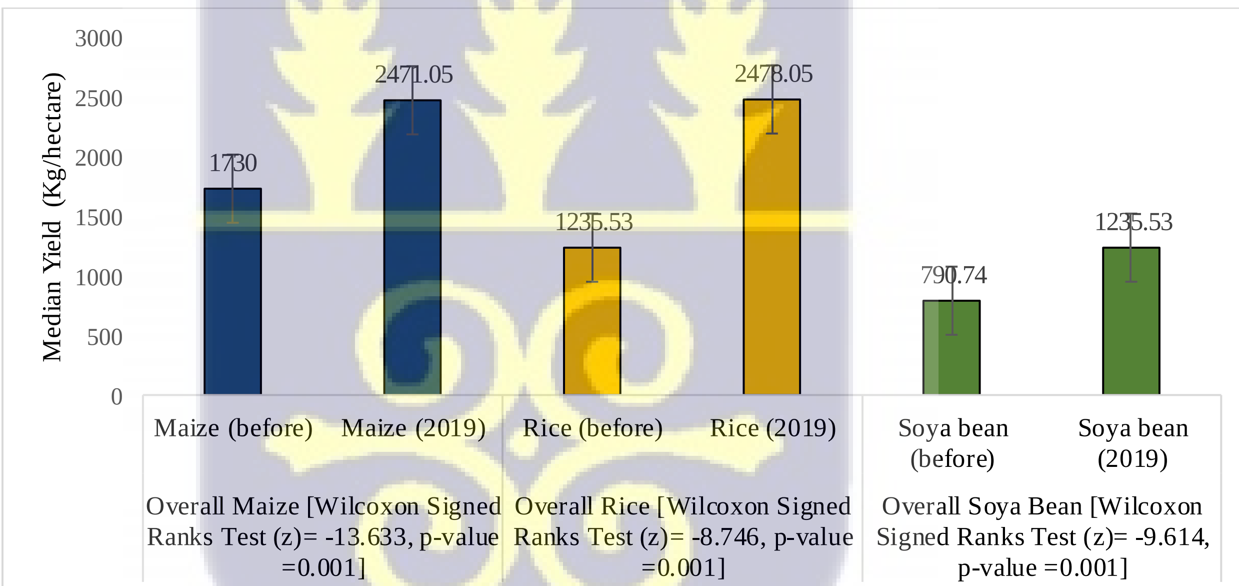

Fig. 4. 4 Comparison between Crop yield (kg/ha) before and after project intervention

Source: Field Data (2020)

Fig 4.5 presents results on crop incomes before and after project implementation. There is evidence that incomes of the farmers with respect to the crops increased after participating in the capacity building. The Wilcoxon sign rank test results show a statistically significant difference in incomes of maize, rice, and soybean at 1% level of significance (Fig 4.5).

The crop income derived from maize was higher after the project intervention compared to before the capacity building. Similar observations are made for rice and soybeans. The results corroborate a study by Wordofa et al. (2021) that using improved agricultural technologies results in a statistically significant gain in household farm income. The results also confirm studies that show that farmers who participate in formal extension programmes achieve higher incomes through improvement in their farm management practices (Danso-Abbeam et al., 2018; Anang et al., 2020). According to Cervantes-Godoy and Dewbre (2010) agricultural productivity growth could be a significant means to poverty reduction in developing economies such as Ghana. Lukuyu et al. (2012) further indicated that agricultural training involving farmer-to-farmer training is an effective way of disseminating relevant new technologies for the purposes of increasing productivity. The results imply that information on relevant agricultural technologies is key in agricultural productivity improvement. It makes information dissemination on agricultural technologies relevant in the effort to reduce poverty in northern Ghana.

Fig. 4. 5 Comparison between Crop Income before and after project intervention

Source: Field Data (2020)

4.3.2.2 Comparison of crop income before and after project intervention with respect to the projects

Figure 4.6 presents results of crop income before and after project implementation with respect to the four projects. Within the projects, the results show that there was a statistically significant improvement in the incomes of the farmers obtained from each of the selected crops after the capacity building compared to before capacity building (p-value <0.05). There was also a statistically significant difference in income between participating farmers between the various projects (Fig 4.6). The income obtained for maize under the Sahel Grains project was the highest (GHS 1400 per acre) among all the projects. The project with the least maize income (GHS 700 per acre) is the USAID/UG FtF Project. On the other hand, rice farmers income under the ATT project was the highest (GHS 1050 per acre). The USAID/UG FtF project participants had the least rice income (GHS 700 per acre). Again, ATT soybean farmers had the highest incomes (GHS 800 per acre) for soybeans compared to all the other projects, and the USAID/UG FtF project participants having the least income. However, in all the projects participants had higher income after the capacity building compared to before capacity building. This result is in conformity with studies by Danso-Abbeam et al. (2018) which revealed that farmers achieve higher incomes when they participate in agricultural project intervention. An earlier study by Agboh-Noameshie et al. (2007) revealed that the adoption of introduced improved varieties of rice has positive and significant impact on farmers' yield and income. In a similar study, Nhan et al. (2020) and Akuriba & Tangonyire (2020) also revealed that participation in the outgrower scheme also has a significantly positive impact on farmers' rice income. In all cases the farmers who participated in the USAID/UG FtF project had the least income for all the three crops compared to the other projects. This is because the farmers only exhibited some level of innovativeness in trying the technology on their own without the appropriate scientific recommendations from the project. At the time of the data collection the farmers were still engaged in the field demonstration under the project but tried to apply the biochar compost under investigation on their own. For the farmers involved in the USAID/UG FtF Project they are experimenting with their experiences during the field demonstration. This finding is in support of a study by Gunawan et al. (2016) who suggested that farmers try technologies introduced to them on small plots before transferring to their main fields. However, it could be projected that with the recommended rates of application of the biochar compost the USAID/UG FtF project will improve their yields (which could lead to higher incomes) as was found out during the field demonstration.

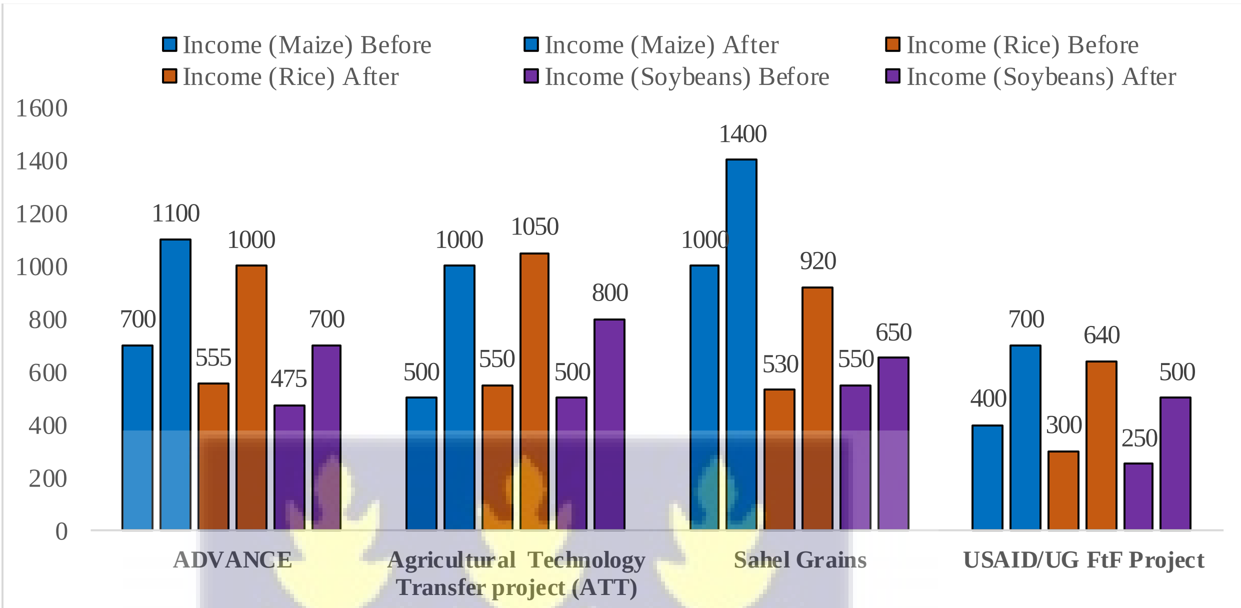

Fig. 4. 6 Comparison of crop income before and after project intervention between projects.

Source: Field Data (2020)

4.3.2.3 Ordinary Least Squares (OLS) regression showing the relationship between crop productivity and income (before and after the projection intervention).

The OLS model results as presented in Table 4.12 indicate that there is a linear relationship between yield and income before and after the capacity building. Also, there is statistically significant relationship between yield and income for all the crops at 1% level of significance (Table 4.12).

Table 4. 12 Relationship between yield and income before and after the Project Intervention

Variables	Unstandardized Coefficients Beta	Standardized Coefficients Beta	R Squared	Adjusted R Square	t	p-value
Average Maize farm income before Crop Yield for Crop (Maize) before	0.338	0.387	0.626	0.625	7.081	0.001
Average Maize farm income after Crop Yield for Crop (Maize) after	0.313	0.611	0.654	0.652	13.457	0.001
Crop Yield for Crop (Rice) before Average Rice farm income before	0.37	0.97	0.965	0.965	46.915	0.001
Crop Yield for Crop (Rice) after Average Rice farm income after	0.427	0.988	0.980	0.979	73.479	0.001
Average Soybeans farm income before Crop Yield for Crop (Soya Bean) before	0.079	0.428	0.567	0.520	6.998	0.001
Crop Yield (Soya Bean) after Average Soybeans farm income after	0.373	0.929	0.620	0.613	37.829	0.001

Source: Field Data (2020)

Using the standardized coefficients, the results show that every unit change in yield gives the farmer an income amount of GHS 0.388 for maize before the capacity building and GHS 0.611 after the capacity building. In the case of rice every unit change in yield gives the farmer GHS 0.097 before the capacity building and GHS 0.988 after the capacity building. For soybean every unit change in yield result in GHS 0.428 before the capacity building and GHS 0.929 after the capacity building. The results show an increase in income of maize and soybean farmers and a marginal increase in income after the capacity building for rice. This result is similar to findings by Anang et al. (2020) who suggested that farmers who participate in formal extension programmes achieve higher incomes through improving their innovative capacities and management practices. In a similar study Danso-Abbeam et al. (2018) estimated the effect of extension services delivered by the Association of Church-Based Development NGOs (ACDEP) on farm productivity and income. The results indicated that the ACDEP extension program had a positive effect on farmer productivity and farm income of the households in the study area. They also found out that participating in ACDEP extension programmes improved welfare through an increase in farmers income. On the contrary in a study to examine the effect of input credit on smallholder farmers' output and income using Masara N'Arziki support project in Northern Ghana, Iddrisu et al. (2018) found out that the project considered farmers who are experienced with large household sizes and farms. The effect was that participation in the project only increased output and yield but not income. They indicated that if output or yield increases, but income is not affected, then there is a disparity between revenues realized and cost of production. This will mean that participant farmers are either incurring higher costs or lower revenues. In that case it is important to conduct a profitability analysis of technologies before introducing the technologies to the farmers.

4.3.3 Relationship between crop productivity and food security

The section presents findings on the relationship between smallholder farmers yield of the selected crops and food security after participating in the USAID FtF capacity building activities. The section begins by presenting and discussing respondents' status of food security using some food security indicators (before and after the capacity building). The indicators are discussed in the following order: whether there was no money to buy food, eat less preferred food, reduce the amount of food served to the male household members, reduce your food consumption, forced to reduce your food consumption, household was compelled to skip meals and household members were compelled to refrain from eating for a whole day.

The number of times respondents ate before and after the capacity building as well as the number of months staple food lasted before the next cropping season before and after the capacity building is also presented and discussed. The effect of crop yield on farmers' food security is also discussed. The Kruskal-Wallis test was used to determine the relationship between yield and food security.

4.3.3.1 Description of respondent's food security status

The results in Table 4.13 indicate that before the capacity building majority of the respondents (71%) indicated that there were occasions when there was no money to buy food (economic access to food). More than 37% indicated they had to eat less preferred food from time to time (2 or 3 times). In the same vein, 9.6% of the respondents indicated they had to eat less preferred food often. Again, few respondents (10.2%) indicated that the household had to reduce the amount of food served to the male household members. Few respondents (11.5%) indicated they had to reduce their own food consumption while 38.9% indicated they rarely had to reduce their own food consumption. Few respondents (8.3%) indicated their households were often compelled to skip meals while 34.7% were never compelled to skip meals. Again, few respondents (6.4%) indicated their household members were compelled to refrain from eating for a whole day while 60.8% indicated they were never compelled to refrain from eating for a whole day.

Table 4. 13 Food security indicators before project intervention

Description	Response	Frequency	Percent
Before the project intervention, were there occasions where there was no money to buy food?	Yes	223	71
	No	91	29
	Total	**314**	**100**
Did your household have to eat less preferred food (less preferred than their favourites) before the project intervention?	Never	53	16.9
	Rarely (once)	113	36
	From time to time (2 or 3 times)	118	37.6
	Often (5 or more)	30	9.6
	Total	**314**	**100**
Did you have to reduce the amount of food served to the male household members before the project intervention?	Never	64	20.4
	Rarely (once)	125	39.8
	From time to time (2 or 3 times)	93	29.6
	Often (5 or more)	32	10.2
	Total	**314**	**100**
Have you been forced to reduce your own food consumption before the project intervention?	Never	81	25.8
	Rarely (once)	122	38.9
	From time to time (2 or 3 times)	75	23.9
	Often (5 or more)	36	11.5
	Total	**314**	**100**
Were members of your household compelled to skip meals before the project intervention?	Never	109	34.7
	Rarely (once)	105	33.4
	From time to time (2 or 3 times)	74	23.6
	Often (5 or more)	26	8.3
	Total	**314**	**100**
Were your Household members compelled to refrain from eating for a whole day before the project intervention?	Never	191	60.8
	Rarely (once)	64	20.4
	From time to time (2 or 3 times)	39	12.4
	Often (5 or more)	20	6.4
	Total	**314**	**100**

Source: Field Data (2020)

The results in table 4.14 indicate that after the project intervention about 23.2% (which is less than the 71% who indicated that there were occasions before the project when there was no money to buy food) indicated there were occasions when there was no money to buy food. This implies that fewer people indicated that there were occasions after the capacity building when there was not sufficient money to buy food. The results also show that after the capacity building, lesser respondents (0.3%) compared to 37% before the project interventions who indicated they had to eat less preferred food often. Fewer respondents (1%) indicated the household had to reduce the amount of food served to the male household members after the capacity building compared to 10.2% before the project intervention. Again, fewer respondents (0.3%) indicated they had to reduce their own food consumption after the capacity building compared to the 11.5% before the project intervention. Few respondents (0.3%) indicated their household were often compelled to skip meals after the capacity building compared to 8.3% before capacity building, and (2.2%) indicated their household members were compelled to refrain from eating for a whole day after the capacity building compared to 6.4% before the capacity building. The results are an indication that more and more people are becoming food secure after the capacity building.

Against all the indicators, it is obvious that fewer people indicated they often suffered the consequences of the indicators after the capacity building. This implies that more people became food secure after the capacity building. The study corroborates findings of a study by (Bawa, 2019) which confirmed that participation in agricultural interventions improves farmers productivity as well as their food security status.

Table 4. 14 Food security indicators after project intervention

Description	Response Category	Frequency	Percent
After the project intervention were there occasions where there was no money to buy food?	Yes	73	23.2
	No	241	76.8
	Total	**314**	**100**
Did your household have to eat less preferred food (less preferred than their favourites) after the project intervention?	Never	204	65
	Rarely (once)	73	23.2
	From time to time (2 or 3 times)	36	11.5
	Often (5 or more)	1	0.3
	Total	**314**	**100**
Did you have to reduce the amount of food served to the male household members after the project intervention?	Never	210	66.9
	Rarely (once)	70	22.3
	From time to time (2 or 3 times)	31	9.9
	Often (5 or more)	3	1
	Total	**314**	**100**
Have you been forced to reduce the amount of food for children in the household after the project intervention?	Never	265	84.4
	Rarely (once)	41	13.1
	From time to time (2 or 3 times)	7	2.2
	Total	313	99.7
	System	1	0.3
	Total	**314**	**100**
Were members of your household compelled to skip meals after the project intervention?	Never	240	76.4
	Rarely (once)	47	15
	From time to time (2 or 3 times)	26	8.3
	Often (5 or more)	1	0.3
	Total	**314**	**100**
Were your household members compelled to refrain from eating for a whole day after the project intervention?	Never	285	90.8
	Rarely (once)	22	7
	From time to time (2 or 3 times)	7	2.2
	Total	**314**	**100**

Source: Field Data (2020)

Figure 4.7 presents results of the number of times respondents eat before and after capacity building. The results revealed that, majority of the respondents (98.41%) eat three times a day after the capacity building compared to 61.78% who ate three times a day before the project intervention. Before the project intervention there were some 8.92% of the respondents who ate once a day, but no one eats once in a day after the capacity building.

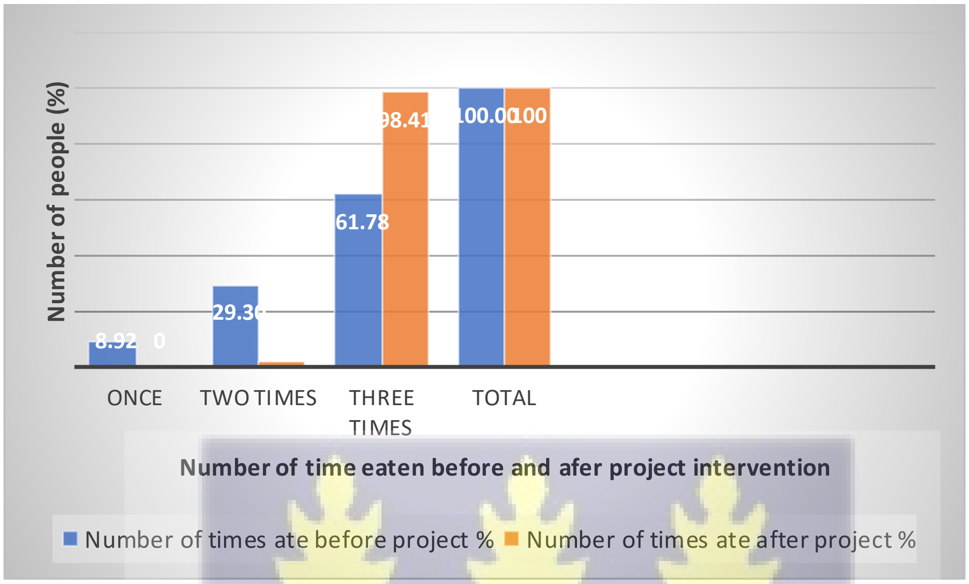

Fig. 4. 7 Number of times respondents ate in a day before and after the project

Source: Field Data (2020)

Fig 4.8 presents the results of the number of months staple food lasted before the next cropping season before and after the capacity building. The results indicate that before the project intervention, it took on the average 6.3 months for their staple food to last before the next cropping season. The results corroborate a study by Quaye (2008) which indicated that most farmer households in northern Ghana experience significant level of food insecurity lasting from 3 to 6 months. On the other hand, after the capacity building the respondents indicated that their food lasted for 8.8 months on average before the next cropping season. Again, there is an indication that food security improved after the capacity building.

Fig. 4. 8 Mean number of months staple food lasted

Source: Field Data (2020)

Table 4.15 presents results of whether project intervention assisted more food for long months before and after the capacity building. The results indicate that over 92% of the respondents either strongly agree or agree that their food lasted longer months before the next cropping season after the project intervention compared to before the project because of the capacity building. Only 1.6% of the respondents disagree that the capacity building enabled their food stock to last more months before the next cropping season.

Table 4. 15 Whether project intervention assisted more food for longer months

Project intervention assisted you to have more food for longer months		
	Frequency	Percent
Strongly agree	105	33.4
Agree	187	59.6
Somewhat Agree	17	5.4
Disagree	5	1.6
Total	**314**	**100**

Source: Field Data (2020)

In the derivation of the farmer/respondent food security status, a reliability test was conducted to measure the selected eight independent variables as shown in Table 4.16. The Cronbach's Alpha coefficient for the eight items yielded 0.905 suggesting that the items have relatively high internal consistency which is higher than the acceptable coefficient of 0.70.

Table 4. 16 Food Security Measure-Reliability test

Item Statistics	Mean	SD	N	Cronbach's Alpha	N of Items
You were worried you would run out of food	1.43	.496	312	0.905	8
You were unable to eat healthy and nutritious food	1.48	.501	312		
You ate only a few kinds of foods	1.51	.501	312		
You had to skip a meal	1.65	.478	312		
You ate less than you thought you should	1.53	.500	312		
Your household ran out of food	1.51	.501	312		
You were hungry but did not eat	1.73	.444	312		
You went without eating for a whole day	1.89	.312	312		

Source: Field Survey, 2020 Response: Yes - one (1); No was (0)

Table 4.17 presents results of Chi-square analysis of comparison of food security among the projects. The chi-square analysis reveals a statistically significant relationship in food security status before and after the capacity building at 5% level of significance for all the projects (Table 4.17). Overall, more people were food secure (54.1%) compared to those who were food insecure (45.9%). However, in ADVANCE and Sahel grains, more people were food insecure compared to those who were food secure (Table 6.6). In the ADVANCE project 55.7% of the people who participated in the capacity building were food insecure. Similarly, the results indicated that more people in the Sahel grains project were food insecure (65.7%) compared to those who were food secure (34.3%). However, the case was different for the ATT project and the USAID/UG FtF project. The two projects had more people who were food secure (67%) in the case of ATT and 71.7% in the case of the USAID/UG FtF project. It implies that in the case of ADVANCE and Sahel Grains where the farmers used their produce to pay for the inputs and services provided them, that might have affected their food security status. In the case of the USAID/UG FtF projects there were no such arrangements to use produce to pay for inputs and services provided.

Table 4. 17 Comparison of food security among projects

	Secure	Insecure	χ^2	df	Sig.
Overall (N=314)	170 (54.1)	144 (45.9)			
ADVANCE	47 (44.3)	59 (55.7)	6.19	1	.013*
Agricultural Technology Transfer project (ATT)	61 (67)	30 (33)	8.578	1	.003*
Sahel Grains	23 (34.3)	44 (65.7)	13.465	1	.000*
USAID/UG FtF Project	43 (71.7)	17 (28.3)	9.177	1	.002*
* The Chi-square statistic is significant at the .05 level.					

Source: Field Data (2020)

4.3.3.2 Effect of crop yield on farmer food security status

Table 4.18 presents results of the effect of crop yield on farmer food security status before and after project intervention using the Kruskal-Wallis test. There is evidence in support of the fact that maize yields improve farmers' food security. This is because the Kruskal-Wallis test was significant at 5% level of significance (Table 4.18). Those who are food secure had higher yield compared to those who are not food secure. The possible reason could be because maize is a major staple food of the people in the study area and also with high yields the farmers are able to sell some of the produce to obtain more income, which will enable them to buy more food and at the same time save some of the produce for consumption. This will be virtually impossible with low yields. This results confirm the results of a study by Siziba et al. (2019) that showed that conservation agriculture has a significant positive effect on maize yield and the period of grain self-provision which is a gross indicator of food security. With respect to rice and soybeans there was no evidence that food security improved. This is because the Kruskal-Wallis test was not statistically significant even at 10% level of significance for rice and soybeans (Table 4.18), although the yield of soybeans is higher for those who were food secure. The possible reason could be that rice and soybeans may not be the main staple food for the people so they would rather sell it than store for consumption. It may also be because the yields were not high enough.

Table 4. 18 Kruskal-Wallis results of productivity and food security

Crop	Food Security	N	Median Yield (kg/hectare)	Kruskal-Wallis H	df	p-value
Maize (2019)	Secure	166	3335.92	22.847	1	0.001
	Insecure	143	2223.95			
	Total	309	2471.05			
Rice (2019)	Secure	90	2471.05	0.043	1	0.836
	Insecure	49	2471.05			
	Total	139	2471.05			
Soya bean (2019)	Secure	121	1284.95	0.707	1	0.4
	Insecure	111	1235.53			
	Total	232	1235.53			

Source: Field Data (2020)

4.3.4 Relationship between crop productivity (kg/ha) and well-being

This section presents findings on the relationship between smallholder farmers' yield and their well-being. The section begins by presenting and discussing the well-being status of the respondents, the perception of the capacity building on their well-being and the effect of the crop yields on well-being. The Kruskal-Wallis test was used to determine the relationship between yield and the well-being of the respondents.

4.3.4.1 Description of well-being status of the respondents

Figure 4.9 presents the results of a before and after analysis of well-being indicators. The selected indicators are purchase of food, purchase productive resources, pay their wards school fees and pay hospital bills. Presently more people can purchase household items, build a house, and start small shops as a way of diversifying income. However, before the capacity building more farmers extended their fields in an attempt to produce more compared to after the capacity building. This may be because after the capacity building the farmers have realized that with the training and knowledge acquired, it is better to increase yield per unit area compared to just expanding their farms.

Commenting on how capacity building has benefitted their community during a focus group discussion some respondents had this to say:

> We used to be afraid of losing our crops when we plant rice uphill and so we always plant in the valleys because of water. When the rains come, they destroy our crops and we are left with nothing. Now we can buy pumping machines and use it to irrigate our rice crops uphill (A male respondent at Wungu, Savelugu District, October 19, 2020).

> Before the project came you could hardly see shops in this community. Now we have shops all over and can get anything we want to buy in the community (A male respondent at Wungu, Savelugu District, October 19, 2020).

> Before the project came when people were sick, we are not able to take them to the hospital because there are no cars. Now we have motor bikes all over that we use in carrying people to the hospital (A male respondent at Wungu, Savelugu District, October 19, 2020).

> When we were children, we ate tuozafi in the evening and ate the left over the next morning and then ate tuozafi again the following evening. Since the project intervention now our children also eat tea with bread and eggs in the morning just like the children in Accra before going to school (A male respondent at Buguelle, Sissala East District, 29th October 2020).

> The project has united us in this community more than before and now we care about each other's welfare. For example, when someone is sick, we quickly mobilise and send the person to hospital because until the person recovers, we do not have peace (A female respondent at Amburi, Lawra Municipal, 30th October 2020)

The results indicate that before the capacity building more people could purchase food (65.3%), pay for school fees (54.1%), pay hospital bills (59.6%) compared to those who could not pay for the same items. Also, before the project majority of the people (67%)

could not pay for productive items such as seeds, chemicals, pesticides for production purposes, could not afford to pay for household items such as mattresses (68%), buy animals for draught power (82%), build a house (76%), start a small shop (92%) e.g., provision or agro-chemicals and also extend their fields for more growing area (83%). However, after the project interventions many more people could pay for all the items under investigation except buying animals for draught power (59.6%) and starting a new shop (63.4%), which all had fewer people who could pay for them.

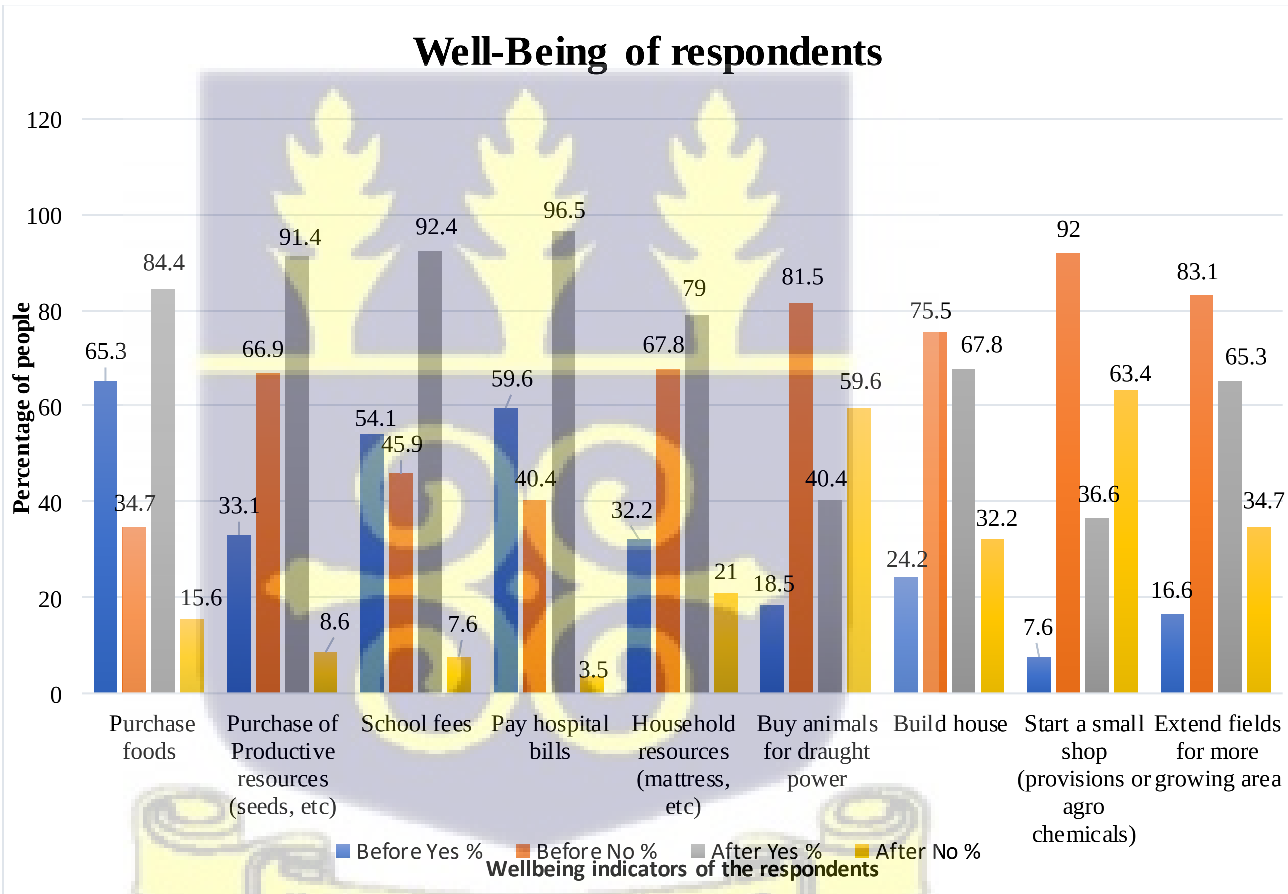

Fig. 4. 9 Well-being of farmers before and after project intervention

Source: Field Data (2020)

4.3.4.2 Perception of project intervention on well-being of respondents

Table 4.19 presents results of the perception of the respondents of the projects on their well-being. The results show that over 77% of the respondents either agree or strongly agree that their ability to purchase food, purchase some productive resources, pay school fees, pay hospital bills, buy some household resources, build a house, start a small shop and extend their farms was due to the capacity building in their communities. About 10% of the respondents either disagree or strongly disagree.

Table 4. 19 Perception about project interventions

Agreement to the fact that project intervention assisted you to patronize the items or activities	Frequency	Percent
Strongly agree	96	30.6
Agree	148	47.1
Somewhat Agree	39	12.4
Disagree	28	8.9
Strongly disagree	3	1
Total	**314**	**100**

Source: Field Data (2020)

In the derivation of the farmer/respondent well-being status, a reliability test was conducted to measure the selected five independent variables as shown in Table 4.20. The Cronbach's Alpha coefficient for the five items yielded 0.930 suggesting that the items have relatively high internal consistency which is higher than the acceptable coefficient of 0.70.

Table 4. 20 Farmer well-being-Reliability Test

Item Statistics	Mean	SD	N	Cronbach's Alpha	N of Items
In most ways my life is close to my ideal	1.94	.928	313		
The conditions of my life are excellent	1.65	.837	313		
I am satisfied with my life	1.79	.919	313	.930	5
So far, I have gotten the important things I want in life	1.65	.865	313		
If I could live my life over, I would change almost nothing	1.63	.833	313		

Source: Field Data (2020) 3- point Likert scale: Disagree=1 Neither agree nor disagree=2 Agree=3

4.3.4.3 Comparison of well-being within projects

Table 4.21 presents results of a comparison of well-being between the projects. The results show that overall, the well-being of most of the people had not improved (73.6%). The Chi-square analysis reveal that there is statistically significant association among those whose well-being improved and those whose well-being did not improve after the capacity building at 5% level of significance for all the projects except the ATT project. Under the ADVANCE, ATT, and Sahel Grains projects most people's well-being has not improved but under the USAID/UG FtF project more people (55.5%) had improved well-being. It means the farmers of the USAID/UG FtF project are satisfied with their lives as compared to the three other projects.

According to Darku and Malla (2010) as cited in Tran et al. (2016) productivity drives the well-being of farmers and at the same time linked to food security and poverty reduction. Wu et al. (2010) found out that upland rice technology had a robust and positive effect on farmers wellbeing. However, over time the technology showed a diminishing impact on wellbeing and therefore recommended that agricultural technology need to be generated and promoted continuously to replace older technologies. On the contrary Dzandu (2015) found little evidence that with an increase in productivity household welfare is assured. The author was of the view that current levels of productivity need to be improved significantly to improve household welfare. This view is confirmed by Chindime et al. (2017) that productivity is driven by the level of innovativeness.

Table 4. 21 Comparison between Farmer Wellbeing among projects

	Improved Wellbeing	Not Improved	χ^2	df	Sig.
Overall	*83 (26.4)*	*231 (73.6)*			
ADVANCE	17 (16)	89 (84)	8.892	1	.003*
Agricultural Technology Transfer project (ATT)	28 (30.8)	63 (69.2)	1.239	1	0.266
Sahel Grains	9 (13.4)	58 (86.6)	7.403	1	.007*
USAID/UG FtF Project	33 (55)	27 (45)	31.127	1	.000*
* The Chi-square statistic is significant at the 0.05 level.					

Source: Field Data (2020)

4.3.4.4 Effect of crop yields on farmer well-being

Table 4.22 presents results on the effect of crop yield on their well-being using the Kruskal-Wallis test. The well-being status of the respondents had to do with their general satisfaction with life. The results revealed that, there was no evidence in support of the fact that maize yields improved farmers well-being. This is because the Kruskal-Wallis test value was not significant even at 10% significance level (Table 4.22).

Table 4. 22 Effect of farmer yield on well-being

Crop	Well-being	N	Median Yield (kg/hectare)	Kruskal-Wallis H	df	p-value
Maize (2019)	Not Improved	226	2471.05	0.09	1	0.765
	Improved Wellbeing	83	2594.6			
	Total	309	2471.05			
Rice (2019)	Not Improved	91	1853.29	7.175	1	0.007
	Improved Wellbeing	48	2471.05			
	Total	139	2471.05			
Soya bean (2019)	Not Improved	174	827.8	17.45	1	0.001
	Improved Wellbeing	58	1482.63			
	Total	232	1235.53			

Source: Field Data (2020)

In the case of maize, the results confirm the results of a study by Dzandu (2015) to assess household welfare effects of agricultural productivity. He found little evidence that with increased productivity household welfare is assured. He was of the opinion that there must be significant increase in the current levels of productivity in order to improve household welfare. People may have money and not be satisfied. They could be food secured and not be satisfied with life. The possible reason for these results is that although yields have improved for the various crops, the current maize yields which are below the potential yield may not be generating enough income for the maize farmers to live satisfactorily.

There is evidence in support of the fact that rice and soybean yield improved farmers well-being. This is because the Kruskal-Wallis test was significant at 1% significance level: rice and soybeans. This may be because rice and soybeans are not staple foods but are mainly sold to enable farmers meet their needs. This results corroborates a study by Islam (2018) which indicated that when improved technologies are adopted productivity increases which results in improvement of household welfare. A similar study by Wu et al. (2010) reveal that the use of improved technologies affects farmers' well-being positively.

4.3.5 Section Summary

In summary, this chapter has examined the relationship between yield and farmers' income, food security and well-being. The results indicate that generally farmers' yield, incomes, food security and well-being have improved after the project interventions. There is also a statistically significant relationship between crop yield and income as well as yield of maize and food security. There was however no significant relationship between rice and soybean yields and food security. There was also no statistically significant relationship between maize yield and farmer well-being. However, there was a statistically significant relationship between yields of rice and soybeans and farmer well-being. In all the cases those with improved well-being had higher yields than those with unimproved well-being. This means that improved productivity of maize does not necessarily translate into well-being for marginal increases in maize productivity. Productivity of maize must improve and improve significantly to achieve well-being status.

CHAPTER FIVE

SUMMARY, CONCLUSIONS AND RECOMMENDATIONS

5.1 Introduction

This chapter summarises the findings made regarding the three research questions raised at the outset of the study. These research questions include how have farmers' participation in the project interventions influenced their innovative performance? How the innovative performance of the farmers affects their yield? and the relationship between yield and poverty reduction? The conclusions drawn from the findings as well as the recommendations made are presented.

5.2 SUMMARY

The key message of the study is that capacity building represents a promising strategy to alleviate poverty among smallholder farmers in northern Ghana. However, without farmer innovativeness in production activities, the induced effect of capacity building may be lower than the expected outcome. In addition, helping farmers to improve their yields is important for poverty reduction.

The main research objective of the study is to ascertain how farmers' participation in the selected USAID FtF capacity building projects implemented in northern Ghana enhanced poverty reduction. The specific objectives that addressed the research questions were to determine the influence of farmer participation in the project activities on their innovative performance, to ascertain the effect of farmer innovative performance on yield, to ascertain the relationship between farmer yield and income, and to determine the relationship between farmer yield and food security and to determine the relationship between farmer yield and well-being. The quantitative survey data was analysed using descriptive statistics such as frequency distributions, cross-tabulations (chi-square), and regression analysis to determine relationships between the variables. Qualitative data from open-ended responses as well as focus group discussions and interviews were analysed using thematic and content analyses. The study was undertaken in all the five northern regions namely Northern, Savannah, Upper West, Upper East, and North East regions. Information rich districts were selected from each of the regions for the specific projects. Primary data was obtained through both quantitative and qualitative means. Data analysis software such as excel, and SPSS were employed to analyse the quantitative data collected.

5.2.1 Influence of farmers participation in agricultural capacity building on their innovative performance

The study revealed that overall majority of the farmers participated fully in the project activities. Similarly, across projects, most of the respondents participated fully in the project activities. On the contrary studies have shown that knowledge is very important and forms the core of innovation. Majority of the respondents exhibited high IP, while a few exhibited low IP. The Chi-square test result at 0.05 alpha level did not show any statistically significant difference between sex, age groups and highest level of education and the levels of participation in the project activities. However, the results show a statistically significant difference between the regions where the projects were undertaken and their level of participation. The results also show a statistically significant difference between project participation and levels of participation. The PCA analysis extracted mainly information sharing and utilization as contributing most to the construct of innovative performance and rendered knowledge redundant. The Chi-square test result did not show any statistically significant difference between age group, marital status and highest level of education and the levels of IP. However, the results show a statistically significant difference between the regions where the projects were undertaken and sex on their innovative performance. The Chi-square test result show statistically significant difference in the levels of participation and IP. The results indicate that at all levels of farmer participation majority of the farmers exhibited high level of IP. The chi-square analysis showed a significant relationship between participation and innovative performance (IP). Those who participated fully had high IP and those who participated partially had medium IP and those with low participation had the least IP.

5.2.2 The relationship between smallholder farmer innovative performance and their yields

The study revealed that participation in the project activities enhanced farmers innovative performance, however innovative performance had no effect on the yields of the selected crops. The results indicate that generally there is increase in yields after the project interventions. There is statistically significant difference in the yields before and after the project interventions. However, the increases in yield did not depend on farmer IP. Farmers with low IP had higher yields for maize and rice compared to those with medium and high IP.

5.2.3 The relationship between smallholder farmers' yield and income

The relationship between yields and farmers income was examined. The results indicate that generally farmers' yield, and incomes have improved after the project intervention. There is a statistically significant relationship between crop yield and income.

5.2.4 The relationship between smallholder farmers' yield and food security

The relationship between yields and farmers' food security was examined. The results indicate that generally farmers' food security has improved after the project intervention. There is evidence to show that maize yield improves food security however, there was no evidence that rice and soybean yields improve food security. There is a statistically significant relationship between the yield of maize and food security. However, there is a statistically non-significant relationship between the yields of rice and soybean and food security. The reason may be because maize is a staple crop of the people hence may not be sold but consumed and stored for future use.

5.2.5 The relationship between smallholder farmers' yield and well-being

The relationship between yields and farmers' well-being was examined. The results indicate that generally farmers well-being has improved after the project intervention. Although there is an indication of improved well-being in terms of ability of farmers to afford certain essential goods and services and also the farmers have more months that their food last before the next cropping season, there is no evidence that maize yield improves farmers' well-being, however there was evidence that rice and soybean yields improve farmers' well-being. There is no statistically significant relationship between maize yield and farmer well-being. However, there is a statistically significant relationship between the yields of rice and soybeans and well-being of the farmers. This may be because maize is a staple crop for the people in the north and may be consumed and some stored for future consumption, while rice and soybean remain cash crops sold for more income to farmers that could be used for the purchase of things that may improve their well-being.

5.3 CONCLUSIONS

The study set out to investigate how farmer participation in the USAID FtF initiative capacity building activities influenced their innovative performance and how that affected their yields. The study also examined the relationship between the yields of the selected crops and the incomes, food security and well-being of the farmers. Analysis of the objectives led to various findings.

Based on the findings, the following conclusions have been drawn based on the research questions posed at the beginning of this thesis. It could be concluded that farmer participation in the USAID FtF capacity building projects influenced their innovative performance in terms of the utilization and sharing of the knowledge and skills acquired from the project activities. The levels of participation in the projects' activities also influenced their levels of innovative performance. Majority of the farmers acquired high knowledge, and majority are also practicing what they have been taught. However, these practices may be restricted to experimental plots to see the effect before transferring unto their main fields.

The study has shown that utilization and sharing of information on knowledge and skills acquired during the capacity building impacted innovative performance. However not many of the farmers are sharing information about the things they have learnt. This has affected the expected increases in yields. This is because farmers innovative performance did not influence the yield of the selected crops as was expected. Farmers decide to participate in capacity building projects mainly for their own benefits, but the study has revealed that it is the utilization and sharing of information that will make the necessary impact in the effort to reduce poverty. It is therefore pertinent for subsequent project designs to concentrate on empowering farmers to utilize and share information so that it will benefit community members, and this is how farmers can complement the efforts of AEAs in providing information to farmers to improve their livelihoods and reduce poverty. Through information sharing more farmers could be reached in remote areas in the effort to alleviate poverty in northern Ghana. Since the yields of the crops improved after farmers participated in the project activities, it means as more farmers get information about the technologies introduced to them from their fellow farmers the higher the yields that will be attained.

The study revealed that there is a statistically significant relationship between yield and income and therefore, the more the number of farmers who benefit from information sharing the higher the yields that will be achieved that will further increase their incomes which has the potential to reduce poverty in northern Ghana. The significant relationship between farmers crop yields and their incomes was expected to impact their food security and well-being.

Although there is a statistically significant relationship between maize yields and food security, there is no statistically significant relationship between rice and soybean yields and food security. It implies that yields of maize must increase significantly and continuously to improve food security in northern Ghana. There is also need for continuous improvement in the yields of rice and soybeans to enhance food security in the region.

There is no statistically significant relationship between maize yield and farmers well-being. However, there is a statistically significant relationship between rice and soybean yields and farmers well-being. It implies that there is the need to improve the yields of maize significantly to improve the well-being of farmers in northern Ghana. Currently the yields of rice and soybeans seems to enhance farmers' well-being but there is the need to sustain yield increases in a continuous fashion to improve well-being of farmers. Generally, there is perceived improvement in income, food security and well-being of the farmers after participating in the project activities. This implies that the capacity building projects have impacted poverty positively and have enhanced poverty mitigation in northern Ghana.

5.4 RECOMMENDATIONS

In view of the observations made and subsequent conclusions arrived at, the following recommendations have been made for agricultural extension practice and for future research.

5.4.1 Recommendations for Agricultural Extension Practice

- The study recommends that government policies and programmes meant to improve farmer innovativeness should target building the capacity of farmers through field demonstrations. The MoFA, NGOs and Donor Agencies should lead this effort.

- Increasing yield requires increased information sharing amongst farmers. Government policies should support innovative farmers to lead farmer to farmer extension. Regional and District MoFA should provide FBOs with professional development activities to build on their networking relations to enhance interactions among the farmers. Information sharing has proven important for innovative performance, and this will allow more community members to benefit from agricultural technologies. FBOs can be used as a hub for greater networking, information sharing on innovations and to address farmers access to technologies. Subsequent project designs should concentrate on empowering farmers to utilize and share information to improve their yields.
- Government policies aimed at increasing farmers' income must be targeted at improving productivity. Government to improve on distribution of quality inputs such as seeds, fertilizer, mechanization etc.) to be available to farmers in a timely manner. Extension service provision should be strengthened to reach farmers on timely basis.
- The study recommends that more effort be put into improvement in the productivity of maize which is the main staple food for the people in the north in order to improve food security. With the significant increase in the yield of maize under the Sahel Grains project it is recommended that Extension Agents adapt their manuals used for the capacity building to improve maize productivity. MoFA to expand mechanization activities (tractor services and

shellers as well as storage facilities) as a sure way of improving food security in northern Ghana.

- There should also be continuous improvement in productivity of rice and soybeans to improve farmers' income to be able to purchase food of their choice.
- Since the productivity of rice and soybeans improved well-being of the farmers and Sahel Grains was observed to use mechanization, the study recommends that mechanisation efforts should be strengthened for rice and soybeans cultivation to improve their productivity for enhanced well-being of farmers in northern Ghana.
- There must also be continuous improvement in productivity of maize to improve farmers' income to be able to purchase their needs for enhanced well-being.

5.4.2 Recommendations for Future Research

i. Since the capacity building projects of the USAID FtF initiative are in the early years, it will be important to carry out further studies in a few years on the innovative performance of the farmers to see how farmers are faring in terms of productivity, incomes, food security and well-being.

ii. The COVID 19 pandemic could not allow detailed qualitative research to be undertaken and therefore a qualitative study could be undertaken to understand farmer innovative performance which is critical for agricultural productivity and poverty reduction in northern Ghana.

iii. Research into the approaches adopted by the USAID/UG FtF project will be useful to help design other capacity building projects to facilitate innovative performance among farmers.

iv. There is also the need to research into how farmers are applying the knowledge on other crops that will inform further research into such technologies.

v. A more quantitative approach could be explored.

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APPENDICES

Appendix 1 Survey Questionnaire

Thank you for accepting to participate in this survey. The purpose of the study is to investigate how your participation in the activities of the capacity building projects enhanced your innovative performance to improve productivity that helped you to achieve increased income, food security and well-being. All information collected will be kept confidential and used only for the intended purpose.

BACKGROUND INFORMATION

A. DATE OF INTERVIEW	
B. GPS POSITION	
C. NAME OF ENUMERATOR	
D. TIME STARTED	
E. TIME COMPLETED	

SECTION A: DEMOGRAPHIC DATA		
1.	**Name of Respondent**	

2.	Region	
3.	District	
4.	Community	
5.	Contact details	Telephone No:
6.	Sex	[1] Male [ ] [2] Female [ ]
7.	Age (years)	
8.	Marital status	[1] Married [ ] [2] Single [ ] [3] Divorced [ ] [4] Separated [ ] [5] Widowed [ ]
9a. 9b.	Have you had formal education?	[1] Yes [ ] [2] No [ ] If no, any informal education? Please specify…………………………… ……………………………………………………………………………………
10.	What is your highest level of education?	[1] Tertiary [ ]

		[2] Vocational [ ] [3] Senior High [ ] [4] Basic [ ] [5] No education [ ] [6] Other (specify) ……………………………………
11.	Household size	Male = Female = Total=
12.	Is respondent the Household Head	[1] Yes [ ] [2] No [ ]
13.	Sex of head of household	[1] Male [ ] [2] Female [ ]
14.	Highest level of education of household head	[1] Tertiary [ ] [2] Vocational [ ] [3] Senior High [ ] [4] Basic [ ]

		[5] No education [ ] [6] Other (specify) ………………………………………
15.	Main occupation of household head	[1] crop farming [ ] [2] livestock rearing [ ] [3] Mixed farming [ ] [3] civil/public service employee [ ] [4] self-employed (non-farm enterprise) [ ] [5] unemployed [ ]
16.	Number of years of farming experience	…………………………………………………
17.	Kindly indicate the USAID project (s) that you participated under the Feed the Future Initiative. (Respondent must relate to only one Project)	[1] ADVANCE [ ] [2] Agricultural Technology project (ATT) [ ] [3] Sahel Grains [ ] [4] USAID/UG FtF Project [ ]
OBJECTIVE 1: To determine the influence of farmer participation in the project activities on their innovative performance.		
SECTION B: PERCEPTION ABOUT THE ADVANCE PROJECT PROCESSES		

18.	Kindly indicate the Activities you participated in under the ADVANCE Project.	[1] Good Agricultural Practices [2] Composting [3] Grain Storage [4] Credit Scheme [5] Other (Specify)……………………………………………… ……………………………………………………………………
19.	Kindly indicate whether you participated in the following activates 1 = Yes 0 = No	[1] Initial project meetings (that explained what the project was about and sought to do) Yes [ ] No [ ] [2] Project meetings during project implementation Yes [ ] No [ ] [3] Group meetings to discuss project implementation Yes [ ] No [ ] **<u>Field demonstrations</u>** [4] Land preparation Yes [ ] No [ ] [5] Compost application Yes [ ] No [ ] [6] Fertilizer application Yes [ ] No [ ] [7] Weeding Yes [ ] No [ ]

		[8] Pesticide application Yes [ ] No [ ] [9] Data collection Yes [ ] No [ ] [10] Harvesting Yes [ ] No [ ]
20.	Please rate on a scale of 1 to 3, the extent to which you agree or disagree with these statements.	(Disagree=1, indifferent =2, agree=3) **Statements** • I attend group meetings regularly [ ] • I participate in group decision making [ ] • I participate in election of group executives [ ] • I fulfil my group contribution obligations [ ] • I participate in outdooring and funeral activities of group members [ ] • I participate in group activities [ ] • I obey the bye-laws and regulations [ ] • Consciously work towards group goals [ ]
21.	How would you rate your level of participation in the ADVANCE Project Activities in general?	[1] low participation [ ] [2] Partial Participation [ ] [3] Full Participation [ ]
22.	Explain your answer to Q. 21	

SECTION C: PERCEPTION ABOUT THE AGRICULTURAL TECHNOLOGY TRANSFER (ATT) PROJECT PROCESSES		
23.	Kindly indicate the Activities you participated in under the ATT Project.	[1] Seed Production [2] Good Agricultural Practices [3] Credit Scheme [4] Others (specify)…………………………………………………………… …………………………………………………………………………..…
24.	Kindly indicate whether you participated in the following activates 1 = Yes 0 = No	[1] Initial project meetings (that explained what the project was about and sought to do) Yes [ ] No [ ] [2] Project meetings during project implementation Yes [ ] No [ ] [3] Group meetings to discuss project implementation Yes [ ] No [ ] **Field demonstrations** [4] Land preparation Yes [ ] No [ ] [5] Compost application Yes [ ] No [ ] [6] Fertilizer application Yes [ ] No [ ] [7] Weeding Yes [ ] No [ ]

		[8] Pesticide application Yes [ ] No [ ] [9] Data collection Yes [ ] No [ ] [10] Harvesting Yes [ ] No [ ]
25.	Please rate on a scale of 1 to 3, the extent to which you agree or disagree with these statements.	(Disagree=1, indifferent =2, agree=3) **Statements** • I attend group meetings regularly [ ] • I participate in group decision making [ ] • I participate in election of group executives [ ] • I fulfil my group contribution obligations [ ] • I participate in outdooring and funeral activities of group members [ ] • I participate in group activities [ ] • I obey the bye-laws and regulations [ ] • Consciously work towards group goals [ ]
26.	How would you rate your level of participation in the ATT Project Activities in general?	[1] low participation [ ] [2] Partial Participation [ ] [3] Full Participation [ ]
27.	Explain your answer to Q. 26	

SECTION D: PERCEPTION ABOUT THE SAHEL GRAINS PROJECT PROCESSES		
28.	Kindly indicate the Activities you participated in under the Sahel Grains Project.	[1] Good agricultural practices [2] Grain storage [3] Credit Scheme [4] Others (specify)…………………………………………………… ‘,,
29.	Kindly indicate whether you participated in the following activates 1 = Yes 0 = No	[1] Initial project meetings (that explained what the project was about and sought to do) Yes [ ] No [ ] [2] Project meetings during project implementation Yes [ ] No [ ] [3] Group meetings to discuss project implementation Yes [No [ ] **Field demonstrations** [4] Land preparation Yes [ ] No [ ] [5] Compost application Yes [ ] No [ ] [6] Fertilizer application Yes [ ] No [ ]

		[7] Weeding Yes [ ] No [ ] [8] Pesticide application Yes [ ] No [ ] [9] Data collection Yes [ ] No [ ] [10] Harvesting Yes [ ] No [ ]
30.	Please rate on a scale of 1 to 3, the extent to which you agree or disagree with these statements.	(Disagree=1, indifferent =2, agree=3) **Statements** • I attend group meetings regularly [ ] • I participate in group decision making [ ] • I participate in election of group executives [ ] • I fulfil my group contribution obligations [ ] • I participate in outdooring and funeral activities of group members [ ] • I participate in group activities [ ] • I obey the bye-laws and regulations [ ] • Consciously work towards group goals [ ]
31.	How would you rate your level of participation in the Sahel Grains Project Activities in general?	[1] low participation [ ] [2] Partial Participation [ ] [3] Full Participation [ ]

32.	Explain your answer to Q. 40	
SECTION E: PERCEPTION ABOUT THE USAID/UG FtF PROJECT PROCESSE		
33.	Kindly indicate the Activities you participated in under the USAID/UG FtF Project.	[1] Biochar preparation (materials to use for making biochar) [2] Biochar compost preparation (materials for making the biochar compost) [3] Biochar compost preparation [4] Biochar and biochar compost application to the soil [5] Others (Specify)…………………………………………… ……………………………………………………………
34.	Kindly indicate whether you participated in the following activates 1 = Yes 0 = No	[1] Initial project meetings (that explained what the project was about and sought to do) Yes [ ] No [ ] [2] Project meetings during project implementation Yes [ ] No [ ] [3] Group meetings to discuss project implementation Yes [ ] No [ ] **Field demonstrations**

		[4] Land preparation Yes [ ] No [ ] [5] Compost application Yes [ ] No [ ] [6] Fertilizer application Yes [ ] No [ ] [7] Weeding Yes [ ] No [ ] [8] Pesticide application Yes [ ] No [ ] [9] Data collection Yes [ ] No [ ] [10] Harvesting Yes [ ] No [ ]
35.	Please rate on a scale of 1 to 3, the extent to which you agree or disagree with these statements.	(Disagree=1, indifferent =2, agree=3) **Statements** • I attend group meetings regularly [ ] • I participate in group decision making [ ] • I participate in election of group executives [ ] • I fulfil my group contribution obligations [ ] • I participate in outdooring and funeral activities of group members [ ] • I participate in group activities [ ] • I obey the bye-laws and regulations [ ] • Consciously work towards group goals [ ]
36.	How would you rate your level of participation in the USAID/UG FtF Activities?	[1] low participation [ ] [2] Partial Participation [ ]

		[3] Full Participation [ ]
37	Explain your answer to Q. 40	
OBJECTIVE 2: To ascertain the effect of farmer innovative performance on yield		
SECTION G: KNOWLEDGE ACQUIRED FROM THE USAID/UG FtF PROJECT		
38.	**Please score 1 for correct answers and 0 for wrong answers**	

List of practices	**Score**
Biochar preparation: what materials are used for making biochar? (Rice husk, saw dust, groundnut husk)	
What materials do you use for preparing the biochar compost? (Biochar, market waste e.g. oranges, green pepper, yams cabbage, farm waste e.g. corn/millet stubbles, groundnut vines cow dung etc.)	
Steps involved in biochar compost preparation • What ratio is used to measure materials?	

		• What is used to mix materials?		
		• What stage do you add water to the materials?		
		• How do you check the level of heat and decomposition?		
		• How frequently do you turn the materials? (Weekly i.e. about 12 times in 3 months)		
		• How do you know the compost is matured? (When the stick placed in the heap no longer generates heat)		
		Explain why you plant in rows		
		Explain why you plant at the recommended spacing		
		Applying fertilizer at the recommended rates and time improves yield (True or false)		
		Explain why you need to control pest and diseases on your farm		
		Explain why you need to control pest and diseases on your farm		
		Explain why you need to weed at the right time		

		Harvesting on time helps to prevent pest infestation (True or false)	
		Explain why you dry to appropriate moisture levels	

SECTION H: KNOWLEDGE ACQUIRED FROM THE ADVANCE PROJECT

39. **Please score 1 for correct answers and 0 for wrong answers**

List of practices	Score
Explain why you need to use certified seeds	
Applying fertilizer at the recommended rates and time improves yield (True or false)	
Explain how to prepare compost Dig a pit Use farm waste and cow dang Bury in the pit	

		In 21 days turn Pour water in the pit every 3 days till maturity		
		Explain why you apply compost first and top dress with inorganic fertilizer		
		Explain why you plant in rows		
		Explain why you plant at the recommended spacing		
		Applying fertilizer at the recommended rates and time improves yield (True or false)		
		Explain why you need to control pest and diseases on your farm		
		Explain why you need to weed at the right time		
		Explain why you need to harvest at the recommended time		

		Explain why you dry to appropriate moisture levels	

SECTION I: KNOWLEDGE ACQUIRED FROM THE SAHEL GRAINS

40. **Please score 1 for correct answers and 0 for wrong answers**

List of practices	**Score**
Using improved varieties increases yields (True or false)	
Explain why you need to use certified seeds	
Explain why you plant in rows	
Explain why you plant at the recommended spacing	
Applying fertilizer at the recommended rates and time improves yield (true or false)	
Explain why you need to control pest and diseases on your farm	
Explain why weed control at the right time is important	

	Harvesting on time helps to prevent pest infestation (True or false)		
	Explain why you need to thresh and dry at the right moisture content		
	Explain why it is important to identify storage pests (primary and secondary pests)		

SECTION J: KNOWLEDGE ACQUIRED FROM THE AGRICULTURAL TECHNOLOGY TRANSFER (ATT)

41. **Please score 1 for correct answers and 0 for wrong answers -**

List of practices	**Score**
Explain why you need to use certified seeds	
Planting in rows leads to improves yields (True or false)	
Planting at the recommended spacing improves yields (True or false)	
Explain why fertilizer should be buried during its application	

	Explain why weed control at the right time is important		
	Explain the need to dry produce to desirable moisture levels		
	Explain why you need to clean and disinfect the store room		
	Explain why you place the bagged produce on pallets		
42.	What practice(s) were you introduced to by the project intervention	[1]Improved genetic materials (seeds/breeds) [2] Zero tillage [3] Minimum tillage [4] Bullock tillage [5] Tractor (Conventional) tillage [6] Mulching [7] Cover cropping [8] Crop rotation [9] Agroforestry [10] Erosion control structures e.g. bunds [11] Use of chemical fertilisers [12] Use of manure/compost [13] Integrated nutrient management [14] Green manuring [15] Water conservation (planting pits, Zai) [16] Climate advisory services [17] Irrigation [18] Integrated pest management [19] Crop-livestock integration [20] No burning of biomass on farms [21] Biogas/Farm waste management	Yes [ ] No [ ] Yes [ ] No [ ]

		[22] Supplementary livestock feeding Yes [ ] No [ ] [23] Livestock diseases prophylactic treatment Yes [ ] No [ ] [24] Preparation of compost Yes [ ] No [ ] [25] Biochar Preparation Yes [ ] No [ ] [26] Biochar Compost Preparation Yes [ ] No [ ]
43.	Have you had any similar trainings previously If yes, from whom?	[1] Yes [ ] [2] No [ ] ………………………………………………………………
44.	Have you utilized knowledge acquired in the USAID Feed the Future Project?	[1] Yes [ ] [2] No [ ]
Kindly respond to the following questions if Yes to the above question.		
45.	If yes kindly indicate the knowledge utilized?	
46.	How have you utilized the knowledge?	
47.	Please indicate whether you have knowledge about these activities.	[1] Preparation of compost [1] Yes [ ] [2] No [ ] [2] Application of compost [1] Yes [ ] [2] No [ ]

		[3] Using certified seeds [1] Yes [ ] [2] No [ ] [4] Planting in lines [1] Yes [ ] [2] No [ ] [5] Using recommended plant spacing [1] Yes [ ] [2] No [ ] [6] Weeding at the recommended times [1] Yes [ ] [2] No [ ] [7] Applying fertilizer at the recommended rate [1] Yes [ ] [2] No [ ] [8] Application of pesticides [1] Yes [ ] [2] No [ ] [9] Dibbling before applying fertilizer [1] Yes [ ] [2] No [ ] [10] Harvesting at the appropriate time [1] Yes [ ] [2] No [ ] [11] Storage of produce at appropriate moisture levels [1] Yes [ ] [2] No [ ]

48.	Please indicate whether you practiced these activities on your farm in the last cropping season?	[1] Preparation of compost [1] Yes [ ] [2] No [ ] [2] Application of compost [1] Yes [ ] [2] No [ ] [3] Using certified seeds [1] Yes [ ] [2] No [ ] [4] Planting in lines [1] Yes [ ] [2] No [ ] [5] Using recommended plant spacing [1] Yes [ ] [2] No [ ] [6] Weeding at the recommended times [1] Yes [ ] [2] No [ ] [7] Applying fertilizer at the recommended rates [1] Yes [ ] [2] No [ ] [8] Application of pesticides [1] Yes [ ] [2] No [ ] [9] Dibbling before applying fertilizer [1] Yes [ ] [2] No [ ] [10] Harvesting at the appropriate time [1] Yes [ ] [2] No [ ] [11] Storage of produce at appropriate moisture levels

		[1] Yes [ ] [2] No [ ]
49.	If Yes to question 56, kindly indicate whether you are able to use the knowledge acquired in crop production decisions?	[1] Able to use [ ] [2] Not able to use [ ] [3] Not sure [ ]
50.	Explain	
51.	In what other ways have you utilized the knowledge acquired from the project?	
52.	Have you contributed to discussions and decision making related to the USAID Feed the Future project at your FBO or CBO meetings?	Yes [ ] No [ ] Not sure [ ]
53.	How did you contribute	

54.	Have you talked to other people about knowledge or information acquired from participating in the USAID Feed the Future Project?	Yes [ ] No [ ] Not sure [ ]
55.	If yes who did you talk to	[1] Relatives [2] Family [3] Friends [4] Others……………….
56.	How many people have you spoken to?	
57.	What did you talk to them about?	
58.	Have you made any contributions to local stakeholder platforms using inputs from the USAID Feed the Future Project?	Yes [ ] No [ ] Not sure [ ]
59.	If yes which platform?	………………………………………………………
60.	What contributions did you make?	
61.	Please indicate the changes that have occurred in your farming	1] Increased yields [2] Increased revenue

	after participating in the USAID Feed the Future Project Activities?	[3] Safeguarding the environment [4] Management of land assets [5]Others (specify) ……………………………….…
62.	Kindly explain your response in Q 85.	
Kindly respond to the following questions if No to Q 68.		
63.	Kindly explain why you have not utilized the knowledge acquired?	
64.	What can be done to help you utilize the knowledge acquired?	
Please indicate a Yes or No, whether you participate in these activities **before participating in the project** and specify activities undertaken		
65.	Participating in community activities	Yes [ ] No [ ] Specify:
66.	Experimenting	Yes [ ] No [ ] Specify:

67.	Sharing information on technology	Yes [ ] No [ ] Specify:
68.	Belonging to local groups	Yes [ ] No [ ] Specify:
69.	Playing roles in local groups	Yes [ ] No [ ] Specify:
70.	Forming groups	Yes [ ] No [ ] Specify:
71.	Attracting resources to aid community	Yes [ ] No [ ] Specify:
72.	Making resources available to the community	Yes [ ] No [ ] specify:
Please indicate a Yes or No, whether you participate in these activities **after participating in the project** and specify activities undertaken		
73.	Participating in community activities	Yes [ ] No [ ] Specify:
74.	Experimenting	Yes [ ] No [ ] Specify:
75.	Sharing information on technology	Yes [ ] No [ ] Specify:

76.	Belonging to local groups	Yes [ ] No [ ] Specify:
77.	Playing roles in local groups	Yes [ ] No [ ] Specify:
78.	Forming groups	Yes [ ] No [ ] Specify:
79.	Attracting resources to aid community	Yes [ ] No [ ] Specify:
80.	Making resources available to the community	Yes [ ] No [ ] specify:
SECTION I: FARM LEVEL CHARACTERISTICS AND YIELD/PRODUCTIVITY		
81.	What type of labour do you use for your farming activities?	[1] Family labour [2] Hired labour [3] Family & Hired labour……..…………………………………
82.	What was the total area of your farming land (s) (*in Acres*)?	[1] 2015 [ ] [2] 2016 [ ] [3] 2017 [ ] [4] 2018 [ ] [5] 2019 [ ]
83.	What have been the average crop yields (*kilograms*) before and after the project intervention? (indicate yield for	**Before Project** **After Project** [1] Maize[ ] [1] Maize [ ] [2] Rice [ ] [2] Rice [ ] [3] Soya bean [ ] [3] Soya bean [ ]

	each crop based on the intervention you participated in)	
84.	What was the crop yields (*kilograms*) for the following crops in 2019 cropping season?	[1] Maize [ ] [2] Rice [ ] [3] Soya bean [ ]
OBJECTIVE 3: To ascertain the relationship between farmer yield and income.		
SECTION J: POVERTY LEVELS: FARMER'S INCOME LEVELS		
85.	What was your average crop farm income (*in Ghana cedi*) before the project intervention?	Maize [ ] Ghana Cedi Rice [ ] Ghana Cedi Soybeans [ ] Ghana Cedi
86.	What is your average crop fam income (*in Ghana cedi*) after the project intervention?	Maize [ ] Ghana Cedi Rice [ ] Ghana Cedi Soybeans [ ] Ghana Cedi
OBJECTIVE 4: To determine the relationship between farmer yield and food security		
SECTION K: POVERTY LEVELS: FARMER'S FOOD SECURITY		
During the last 12 months, was there a time when, because of lack of money or other resources:		

87.	You were worried you would run out of food?	[1] Yes [2] No
88.	You were unable to eat healthy and nutritious food?	[1] Yes [2] No
89.	You ate only a few kinds of foods?	[1] Yes [2] No
90.	You had to skip a meal?	[1] Yes [2] No
91.	You ate less than you thought you should?	[1] Yes [2] No
92.	Your household ran out of food?	[1] Yes [2] No
93.	You were hungry but did not eat?	[1] Yes [2] No
94.	You went without eating for a whole day?"	[1] Yes [2] No
95.	How many months does the staple food for the household last till the next season or	**Before project** [ ] months **After project** [ ] months

	harvest **(before the project intervention)?**	
96.	Do you agree that the project intervention assisted you to have more food for longer months? *(if more months after the project intervention)*	[1] Strongly agree [ ] [2] Agree [ ] [3] Somewhat Agree [ ] [4] Disagree [ ] [5] Strongly disagree [ ]
97.	Before the project intervention were there occasions where there was no money to buy food?	[1] Yes [2] No
98.	After the project intervention were there occasions where there was no money to buy food?	[1] Yes [2] No
99.	How many meals did your adult household members have in a day *before the project intervention*?	[ ]
100.	How many meals did your adult household members have in a	[ ]

	day *after the project intervention*?	
101.	Did your household have to eat less preferred food (less preferred than their favourites) ***before the project intervention?***	[1] Never [2] Rarely (once) [3] From time to time (2 or 3 times) [4] Often (5 or more)
102.	Did your household have to eat less preferred food (less preferred than their favourites) ***after the project intervention*?**	[1] Never [2] Rarely (once) [3] From time to time (2 or 3 times) [4] Often (5 or more)
103.	Did you have to reduce the amount of food served to the male household members ***before the project intervention*?**	[1] Never [2] Rarely (once) [3] From time to time (2 or 3 times) [4] Often (5 or more)
104.	Did you have to reduce the amount of food served to the male household members ***after the project intervention*?**	[1] Never [2] Rarely (once) [3] From time to time (2 or 3 times) [4] Often (5 or more)
105.	Have you been forced to reduce your own food consumption ***before the project intervention***?	[1] Never [2] Rarely (once) [3] From time to time (2 or 3 times) [4] Often (5 or more)

106.	Have you been forced to reduce your own food consumption ***after the project intervention***	[1] Never [2] Rarely (once) [3] From time to time (2 or 3 times) [4] Often (5 or more)
107.	Have you been forced to reduce the amount of food children in the household ***before the project intervention***?	[1] Never [2] Rarely (once) [3] From time to time (2 or 3 times) [4] Often (5 or more)
108.	Have you been forced to reduce the amount of food for children in the household ***after the project intervention***?	[1] Never [2] Rarely (once) [3] From time to time (2 or 3 times) [4] Often (5 or more)
109.	Were members of your household compelled to skip meals ***before the project intervention***?	[1] Never [2] Rarely (once) [3] From time to time (2 or 3 times) [4] Often (5 or more)
110.	Were members of your household compelled to skip meals ***after the project intervention***?	[1] Never [2] Rarely (once) [3] From time to time (2 or 3 times) [4] Often (5 or more)

111.	Were your Household members compelled to refrain from eating for a whole day ***before the project intervention***?	[1] Never [2] Rarely (once) [3] From time to time (2 or 3 times) [4] Often (5 or more)
112.	Were your Household members compelled to refrain from eating for a whole day ***after the project intervention*?**	[1] Never [2] Rarely (once) [3] From time to time (2 or 3 times) [4] Often (5 or more)
OBJECTIVE 5: To determine the relationship between farmer yield and well-being.		
SECTION K: POVERTY LEVELS: FARMER'S WELL BEING		
Below are five statements which you may agree or disagree to. Using the 1-3 scale, indicate your agreement with each item by placing the appropriate number in the box provided at the end of the item. Please be open and honest in responding. The 3- point scale is as follows: Disagree=1 Neither agree nor disagree=2 agree=3		
113.	In most ways my life is close to my ideal	[ ]
114.	The conditions of my life are excellent	[ ]
115.	I am satisfied with my life	[ ]
116.	So far I have gotten the important things I want in life	[ ]

117.	If I could live my life over, I would change almost nothing	[ ]
118.	Please indicate your farm assets of the following farm machinery/equipment **before the project implementation**	[1] Trained bullocks Yes [ ] No [ ] [2] Tractor Yes [ ] No [ ] [3] Ridger Yes [ ] No [ ] [4] Ripper Yes [ ] No [ ] [5] Power tiller Yes [ ] No [ ] [6] Jab planter Yes [ ] No [ ] [7] Crimper Yes [ ] No [ ] [8] Mechanized planter Yes [ ] No [ ] [9] Motor King Yes [ ] No [ ] [10] Donkey Yes [ ] No [ ] [11] Manual thresher Yes [ ] No [ ]
119.	Please indicate your farm assets of the following farm machinery/equipment **after the project intervention.**	[1] Trained bullocks Yes [ ] No [ ] [2] Tractor Yes [ ] No [ ] [3] Ridger Yes [ ] No [ ] [4] Ripper Yes [ ] No [ ] [5] Power tiller Yes [ ] No [ ] [6] Jab planter Yes [ ] No [ ] [7] Crimper Yes [ ] No [ ] [8] Mechanized planter Yes [ ] No [ ] [9] Motor King Yes [ ] No [ ] [10] Donkey Yes [ ] No [ ] [11] Manual thresher Yes [ ] No [ ]
120.	To what extent do you agree that the project intervention assisted you to acquire the above assets?	[1] Strongly agree [ ] [2] Agree [ ] [3] Somewhat Agree [ ] [4] Disagree [ ] [5] Strongly disagree [ ]

121.	Did you own any of the following **before the project intervention**?	Car, jeep, van Yes [ ] No [ ] Tricycle, motorcycle, e-bike Yes [ ] No [ ] Bicycle Yes [ ] No [ ] Television Yes [ ] No [ ] Radio/Radio cassette Yes [ ] No [ ] Cell phone Yes [ ] No [ ] Computer/Laptop Yes [ ] No [ ] Refrigerator/Freezer Yes [ ] No [ ] LPG gas stove/electric stove Yes [ ] No [ ] Rice cooker Yes [ ] No [ ] Working Box iron Yes [ ] No [ ]
122.	Do you own any of the following **after the project intervention**?	Car, jeep, van Yes [ ] No [ ] Tricycle, motorcycle, e-bike Yes [ ] No [ ] Bicycle Yes [ ] No [ ] Television Yes [ ] No [ ] Radio/Radio cassette Yes [ ] No [ ] Cell phone Yes [ ] No [ ] Computer/Laptop Yes [ ] No [ ] Refrigerator/Freezer Yes [ ] No [ ] LPG gas stove/electric stove Yes [ ] No [ ] Rice cooker Yes [ ] No [ ] Working Box iron Yes [ ] No [ ]
123.	To what extent do you agree that the project intervention assisted you to acquire the above assets?	[1] Strongly agree [ ] [2] Agree [ ] [3] Somewhat Agree [ ] [4] Disagree [ ] [5] Strongly disagree [ ]
124.	In what type of building/dwelling did you reside in **before the project intervention**?	[1] Mud House Yes [ ] No [ ] [2} Cemented Mud House Yes [ ] No [ ] [3 Cemented House Building Yes [ ] No [ ] [4] Tent/improvised home Yes [ ] No [ ]

125.	In what type of building/dwelling do you reside in **after the project intervention?**	[1] Mud House Yes [ ] No [ ] [2} Cemented Mud House Yes [ ] No [ ] [3 Cemented House Building Yes [ ] No [ ] [4] Tent/improvised home Yes [ ] No [ ]
126.	Do you agree that the project intervention assisted you to acquire the above building? *(If dwelling in a different place)*	[1] Strongly agree [ ] [2] Agree [ ] [3] Somewhat Agree [ ] [4] Disagree [ ] [5] Strongly disagree [ ]
127.	What was your main source of cooking fuel **before the project intervention?**	[1] Wood/crop residue Yes [ ] No [ ] [2] Sawdust/animal waste Yes [ ] No [ ] [3] Charcoal/kerosene Yes [ ] No [ ] [4] Gas/electricity Yes [ ] No [ ]
128.	What is your main source of cooking fuel **after the project intervention?**	[1] Wood/crop residue Yes [ ] No [ ] [2] Sawdust/animal waste Yes [ ] No [ ] [3] Charcoal/kerosene Yes [ ] No [ ] [4] Gas/electricity Yes [ ] No [ ]
129.	Do you approve that the project intervention assisted you to acquire a different source of cooking fuel? *(If cooking source is different)*	[1] Strongly agree [ ] [2] Agree [ ] [3] Somewhat Agree [ ] [4] Disagree [ ] [5] Strongly disagree [ ]
130.	Were you able to patronize these items or activities **before the project intervention?**	[1] Purchase foods Yes [ ] No [ ] [2] Purchase of productive resources (seeds, etc) Yes [ ] No [ ]

		[3] School fees Yes [ ] No [ ] [4] Pay hospital bills Yes [ ] No [ ] [5] Household resources (mattress, etc) Yes [ ] No [ ] [6] Buy animals for draught power Yes [ ] No [ ] [7] Start a small shop (provisions or agro chemicals) Yes [ ] No [ ] [8] Extend fields for more growing area Yes [ ] No [ ]
131.	Were you able to patronize these items or activities **after the project intervention?**	[1] Purchase foods Yes [ ] No [ ] [2] Purchase of Productive resources (seeds, etc) Yes [ ] No [ ] [3] School fees Yes [ ] No [ ] [4] Pay hospital bills Yes [ ] No [ ] [5] Household resources (mattress, etc) Yes [ ] No [ ] [6] Buy animals for draught power Yes [ ] No [ ]

		[7] Start a small shop (provisions or agro chemicals Yes [ ] No [ ] [8] Extend fields for more growing area Yes [ ] No [ ]
132.	Do you agree that the project intervention assisted you to patronize the items or activities?	[1] Strongly agree [ ] [2] Agree [ ] [3] Somewhat Agree [ ] [4] Disagree [ ] [5] Strongly disagree [ ]

Appendix 2 Group Discussion Guide

FOCUS GROUP DISCUSSION GUIDE FOR PARTICIPATING FARMERS

(Opinion leaders/key informants will be included in this group discussion)

A. INTRODUCTION

1. Ensure that seating arrangements, in a semi-circle, facilitate a smooth exchange of ideas.
2. Ensure social distancing and use of face masks and sanitizers.
3. Create a congenial environment to welcome the participants as they arrive individually at the venue.
4. Allow group exchange of greetings and self-introduction of all present, researchers, recordist and panellist while observing social protocols
5. Give an explanation of the objectives of the meeting:

We are conducting a study on farmers' innovative performance on the USAID Feed the future Initiative. As farmers (producers) who participated in the programme, we would like to discuss your activities and some issues concerning your farming enterprise.

6. Explanation of the procedures for the discussion

The discussion will be held in a number of components. Each component is to be appropriately introduced and concluded. Participants will be expected to restrict their responses to the specific demands of each question so that the discussion will remain focused. Everyone is expected to speak up and freely.

B. OBJECTIVE ONE: To determine the influence of farmer participation in the project activities on their innovative performance.

- Nature of group meetings to discuss project implementation (the form it takes)
- Describe the nature of the field demonstrations
- What do have to show that you have participated in the FTF Project/what have you gained from participating in the FTP project/what are you doing now that you were not doing before you joined the project
- How would you assess the project processes in terms of accountability to its beneficiaries?/what are your impressions?
- How would you assess the project processes in terms of level of transparency to beneficiaries?
- How would you rate the project processes in terms of quality of communication to beneficiaries?
- How appropriate has the sharing of Scientific knowledge been within the project Activities?
- How appropriate has the sharing of Local knowledge been within the project Activities?

C. OBJECTIVE TWO: To ascertain how farmers' innovative performance improved their productivity (their input/labour use efficiency).

- Group understanding of innovative performance
- Group understanding of productivity
- Explain how innovative performance is helping you to improve your productivity

D. OBJECTIVE THREE: To ascertain the extent to which farmers' productivity improvement affected their income.

- Explain understanding of income

- Explain how productivity contributed to income

<u>E. OBJECTIVE FOUR</u>: To determine the extent to which farmers' productivity improvement influenced their food security levels (ask a before and after)

- Explain what food security is
- Explain how productivity is related or contributing to food security

<u>F. OBJECTIVE FIVE</u>: To determine the extent to which farmers' productivity improvement resulted in their well-being.

- Explain what well-being is
- Explain how productivity is related or contributing to well-being

Thank you.

Appendix 3 Rotated Component Matrix

	Raw component			Rescaled component		
	1	2	3	1	2	3
Knowledge Score for participants						
Practicing	-.054		-.044	-.163		-.133
Have you contributed to discussions and decision making related to the USAID Feed the Future project at your FBO or CBO meetings?		.180	.684		.253	.962
Have you talked to other people about knowledge or information acquired from participating in the USAID Feed the Future Project?	.114	.548	.106	.172	.827	.160
Have you made any contributions to local stakeholder platforms using inputs from the USAID Feed the Future Project?	.073	.504	.120	.114	.784	.187
Experimenting	.208	.129	-.048	.460	.286	-.107
Attracting resources to aid community	.407		.047	.936		.109
Making resources available to the community	.405			.940		

Appendix 4 USAID Feed the Future Initiative projects in Ghana, objectives, and their approaches

USAID FtF Projects	Objectives	Approaches
Africa Lead is a capacity-building program.	The goal of Africa Lead is to strengthen and improve institutional capacity, foster agricultural policy reforms and to strengthen capacity and engagement of Non-State Actors.	Africa Lead seeks to advocate for agricultural policy reform and contribute to achieving the FtF goals of hunger and poverty reduction through capacity building of Champions who will lead, develop, and manage the institutions and systems needed to sustain the agricultural transformation process.
The FtF Ghana Agriculture and Natural Resource Management Project (AgNRM).	The goal of AgNRM Project is to reduce poverty sustainably by increasing wealth and nutrition from natural and non-traditional agriculture products and also address challenges in agriculture, the environment, natural resource management and governance.	AgNRM's targets the successful Community Resource Management Area (CREMA) model promoted by Forestry Commission through the Wildlife Division of the Government of Ghana's (GoG). The approach used under CREMA addresses landscape-level protected area management and biodiversity conservation, and at the same time catalyses sustainable livelihoods in natural resource products.
Agriculture Policy Support Project (APSP)	The main goal of APSP is to strengthen the FtF crops competitiveness, and marine fisheries value chains for broad-based and sustained economic growth.	The approach adopted involves provision of support in the effective engagement of the public and the private sectors engagements on agricultural policy discussion processes that contribute to USAID's overall goal of promoting broad-based, sustained, and inclusive economic growth in Ghana
Borlaug Higher Education for Agricultural Research and Development (BHEARD)	BHEARD provides opportunities for Ghanaian institutions to build their capacity in research, production, trade, policy, management, and outreach to promote greater agriculture-led economic growth and natural resources management. This is done through the provision of MSc and PhD degrees from US land grant universities. BHEARD also offers short-term training opportunities for groups, organizational leaders, and staff working in USAID/Ghana's FtF strategy areas.	Through its implementing partner, Michigan State University, the BHEARD program provides support for both short and long-term training of researchers in the field of agriculture at both master's and doctoral levels thereby linking scientific and higher education communities in FtF countries and the United States.
The Coastal Sustainable Landscape Project (CSLP)	The project aims at contributing to moving Ghana into a low greenhouse gas emission, high carbon sequestration development pathway in the land-use sector. CSLP also aims to strengthen capacity for low emissions development in the six coastal districts of the Western Region by improving livelihoods through enhanced practices in natural resource management	The primary activities of CSLP include focusing on community-level interactions to achieve low emissions development. **The** application of a Village Savings and Loan Association (VSLA) model that helps in maintaining and increasing forest cover with native and existing tree species.is a key component of the CSLP strategy.

	Strengthened stakeholder engagement and coordination on sustainable landscape management; and enhanced capacity for ecosystem services monitoring	
The USAID/UCC Fisheries and Coastal Management Capacity Building Support Project	The project is expected to strengthen the Department of Fisheries and Aquatic Sciences' (DFAS) capacity to provide quality and relevant educational programs, practical research and advisory services that will support the management of fisheries and coastal resources on a sustainable basis to enhance the nation's socio- economic development.	The capacity building actions involve improvement in governance of marine fisheries resources, supporting supplementary livelihoods and enhance the nutritional status of households.
The Ghana Commercial Agricultural Project (GCAP)	GCAP aims to enhance commercial farming to ensure wealth creation and food security in the country. The goals of GCAP as follows: increasing yield (for maize, rice and soybeans) by 40%. increasing gross margins (maize, rice and soybeans) by 40%; reaching about 14,000 direct beneficiaries of which 40% are women: and increasing improved irrigation by 10,000 hectares	To achieve these objectives, GCAP is assisting farmers by rehabilitating and modernizing various public irrigation infrastructure, including the Kpong Irrigation Scheme (KIS), the Tono and Vea irrigation dams in the Upper East Region and the Kpong Left Bank Irrigation Project (KLBIP)
The Ghana Supply Chain Development (SCD) Program	The program's goal is to improve the competitiveness of Ghanaian small and medium enterprises (SMEs) in the oil and gas, mining, power and other related sectors by: Building the capacity of SMEs to supply to the oil and gas, mining, power and other related sectors Creating market linkages between SMEs and the industry Increasing the understanding of SMEs of the procurement requirement and standards of the industry Increasing the capacity of local business service providers (BSPs) to serve SMEs	The project introduced training and capacity building interventions targeting the enhancement of technical managerial qualifications of professionals across the sector(s), strategic and targeted campaigns to combat access to finance issues inherent to the Ghanaian private sector, and increasing market linkages amongst market participants both domestic and international.
Monitoring, Evaluation and Technical Support Services (METSS) project	METSS seeks to: Provide research and analysis to support the activities of USAID|Ghana Economic Growth Office;	METSS provides support services to over 50 USAID implementing partners under the EG office portfolio of projects, and Government of Ghana partners to reinforce collective efforts in the agriculture, nutrition, trade and energy sectors.

	Build the capacity of other USAID|Ghana Economic Growth Office implementing partners (projects) and Government of Ghana partners to better monitor and evaluate their activities; and Collect, collate, process, store and disseminate information on the outputs, outcomes, and impact of USAID interventions to stakeholders. The USAID METSS project contributes to USAID's goal of seeing 'Ghana's transition towards established middle-income country status accelerated'.	
Power Innovation in Commercial Agriculture (PICA) project is being implemented by Integrated Water & Agricultural Development Ghana Ltd.	The goal of PICA is to: Build infrastructure for a solar hybrid power generation system Secure the provision of low-cost power for irrigated farming Improve productivity of smallholder out-growers through the application of smaller solar irrigation initiatives	The project forged strategic partnerships, innovating efficient power generation and utilization, up-scaling use of smaller irrigation systems, and supporting smallholder farmers reduce costs and increase farm income.
Resiliency in Northern Ghana (RING) Project	RING works toward the following Feed the Future goals for children under five: 20% decrease in the prevalence of stunting; 20% decrease in the prevalence of underweight; 20% decrease in the prevalence of anaemia; and 20% decrease in the prevalence of wasting	RING is implemented through a collaborative approach with Metropolitan, Municipal and District Assemblies (MMDA) and the Northern Regional Coordinating Council.
Smart Agri-Finance Project.	The project aims to increase commercial opportunities for smallholder farmers in targeted value chains by scaling up a best practice market-based approach to sustainably increase access to finance that focuses on a combination of credit and savings products, education, outreach, and other financial and insurance products.	Smart Agri-Finance's theory of change is that access to appropriate mobile banking and lending products with requisite financial education, leads to both networking and strategic alliances and increased commercial opportunities. Smart Agri-Finance is to leverage financial inclusion-based activities to increase commercial opportunities for Feed the Future beneficiaries through: Increased access to affordable, inclusive savings and lending services; Improved efficiency and linkages along targeted value chains, through facilitated agricultural lending; Promotion of inclusive banking, mobile finance and agricultural lending in Ghana.
The Soybean Innovation Lab's (SIL)	SIL goals are as follows:	SIL brings together leading soybean researchers in both the U.S. and Africa, in the social and natural sciences. The scientists are to provide

	Improved capacity of 5 plant breeding stations with a 3-fold improvement in productivity; Development and release of 9 high-yielding cultivars and 2 high yielding low processing cultivars; Graduate three cohorts of students with a preeminent master's degree in Plant Breeding in Africa; Establish and disseminate best management and seed practices for small and medium soybean producers in northern Ghana; Improve soybean yield from 0.5 to 1.5 metric tons/ha through adoption of appropriate agronomic practices and improved seeds; Identify the gender constraints and the cost and returns of small-scale soybean production; Identify the critical factors for sustainable soy dairy entrepreneurial success; and Identify critical value chain factors for high yield soybean production, particularly the role of information communications, and technology (ICT), physical infrastructure, and market access.	technical knowledge and innovation to enhance the achievement of the soybean development-to-commercialization process in sub-Saharan Africa and other emerging countries.
Under SIL, SARI is developing new improved soybean varieties that are responsive to farmer needs in northern Ghana. It is also working to increase the availability of seed to farmers by engaging in the production of breeder seed of improved varieties for private seed companies to produce certified seed for farmers.	The main goal of the SARI Soybean Innovation Lab is to increase household income and the nutritional status of farmers across northern Ghana and beyond	This goal is to be achieved by developing improved soybean varieties suitable for the ecological and farming systems of northern Ghana. Improvement of the research infrastructure and technical capabilities of researchers; and Creation of linkages and resource support platforms for sustainable breeding work SARI collaborates with the University of Illinois/ United States Department of Agriculture and the International Institute of Tropical Agriculture in the area of germplasm exchange and capacity development for breeders and allied staff; and SMART FARM for agronomic interventions in soybean cultivation.

The Ghana Sustainable Fisheries Management Project (SFMP)	The project seeks to rebuild targeted marine fisheries stocks (small pelagics), to end overfishing through a multifaceted approach: • Improved legal enabling conditions for co-management, use rights and effort reduction strategies • Strengthened information systems and science-informed decision-making • Increased constituencies that provide the political and public support needed to rebuild fish stocks • Implementation of applied management initiatives for several target fisheries ecosystems	Working closely with the Ministry of Fisheries and Aquaculture Development and The Fisheries Commission, the project focuses on the management of small pelagic fisheries at the national scale as well as demersal fisheries and essential mangrove fish habitat in the Pra Estuary (eastern coast) and Ankobra Estuary (west coast) of the Western Region. SFMP is promoting participatory, ecosystem-based and adaptive management approaches.

Source: Author's own compilation from literature (2020)