UNIVERSITY FOR DEVELOPMENT STUDIES, TAMALE

SMALL-SCALE IRRIGATION FARMING AND ITS EFFECTS ON RURAL LIVELIHOOD IN THE WA WEST DISTRICT OF GHANA

PROSPER NIFAAKANG

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BY

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THESIS SUBMITTED TO THE DEPARTMENT OF GOVERNANCE AND DEVELOPMENT MANAGEMENT, FACULTY OF PLANNING AND LAND MANAGEMENT, UNIVERSITY FOR DEVELOPMENT STUDIES, IN PARTIAL FULFILLMENT OF THE REQUIREMENTS FOR THE AWARD OF MASTER OF PHILOSOPHY DEGREE IN DEVELOPMENT MANAGEMENT

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DECLARATION

Student

I hereby declare that this research, "SMALL-SCALE IRRIGATION AND ITS EFFECTS ON RURAL LIVELIHOOD IN THE WA WEST DISTRICT OF GHANA" is the outcome of my independent investigation towards my MPhil Development Management degree. Except for references and quotations which have been duly acknowledged, the work has never been submitted partly or wholly and accepted for the award of any degree elsewhere. I, therefore, accept responsibility for any shortfalls and omissions contained in this work.

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Supervisor

I hereby declare that the preparation and presentation of the thesis were supervised following the guidelines on supervision of thesis laid down by the University for Development Studies.

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Name: DR. NICHOLAS FIELMUA

ABSTRACT

Irrigation has proven to be one of the surest ways of increasing agriculture production, particularly in arid areas. Notwithstanding this, the opportunity has not been optimally utilised to better the lots of rural smallholder farmers. This study, therefore, sought to examine how irrigation systems are governed, the contribution of irrigation to livelihood enhancement and relationship between irrigation farming and migration in the Wa West District. This study was conducted using a mixed-methods approach. The respondents comprise 137 irrigation farmers, 83 in Baleufili and 54 in Yeliyiri, 2 key informants from MOFA and GIDA, and two focus group discussions with the executives of the water user associations in the two study areas. The results showed irrigation is governed at both informal and formal levels; thus, the executives of water user associations and GIDA respectively. The irrigation farmers have rules and regulations including contribution towards maintenance, not farming closer to the banks of the dam that help in the governance and sustainability of the dams. Although the rules are adhered to, the farmers do not have enough financial capacity to maintain the facilities. Governance at both the informal and formal levels have not been effective. Inadequate and untimely budgetary allocation to undertake GIDA's responsibilities and inadequate extension personnel at MoFA are some of the constraints faced by the formal governance level. Farmers therefore do not get the requisite training, advice and supervision needed for their activities. The major source of income of respondents is farming while others engaged in other activities like pito brewing, craftsmanship, livestock rearing. The study also revealed that irrigation farming affects the livelihood of their households through the provision of food, employment and income. Despite the presence of irrigation farming, out-migration is still prominent because of the challenges like pest and disease infestation, low yield among others. The challenges irrigation facilities face makes respondents seek alternative livelihoods elsewhere. Challenges that were identified by the irrigation farmers include; no ready markets, poor pricing of produce, disease and pest infestation, poor mechanisation of dams, and no fence. Recommendations that have been proferred to assist farmers make the best out of the irrigation include; dry season farming should be promoted by making the various Water User Groups formidable by sensitising them to undertake activities that can help them access credit, dictate prices of their produce and have access to ready markets. Irrigation farmers should be given relevant information through extension services that can help them in their activities.

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I also thank the Assemblyman of Baleufili, Chiefs, irrigation farmers and executives of the Water Users Groups in my study areas for their cooperation. Also, to the Ghana Irrigation Development Authority, Upper West Region and the Wa West District Department of Agriculture, I thank you for granting me audience through your representatives.

I pray for God's blessings in all your endeavours.

DEDICATION

This research work is dedicated to my family, the Alhassan family and anyone who has contributed in diverse ways towards my life.

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LIST OF ABBREVIATIONS

DFID	Department for International Development
EPA	Environmental Protection Agency
FAO	Food and Agriculture Organisation
FASDEP	Food and Agriculture Sector Development Policy
GIDA	Ghana Irrigation Development Authority
GIZ	Deutsche Gesellschaftfür Internationale Zusammenarbeit
GoG	Government of Ghana
GSS	Ghana Statistical Service
ICOUR	Irrigation Company of Upper East Region
IFC	International Finance Corporation
IFDC	International Fertilizer Development Centre
MOFA	Ministry of Food and Agriculture
NGO	Non-governmental Organisation
PFJ	Planting for Food and Jobs
SLF	Sustainable Livelihood Framework
SSA	Sub-Saharan Africa
UNDP	United Nations Development Programme
URT	United Republic of Tanzania
WCED	World Commission on Environment and Development
WWDA	Wa West District Assembly
WUA	Water User Association

CHAPTER ONE

INTRODUCTION

1.0 Background of the Study

Water is a natural resource which is used as an input for agriculture and for producing different goods in factories for industrial purposes. Despite such importance, the world is still experiencing water scarcity; thus, supply is unable to meet demand (World Commission on Dam, 2000; Bengali, 2009; Guppy & Anderson, 2017), making irrigation-based agriculture a necessity. Irrigation is a method of providing water artificially to crops to aid growth. This technique is used when there is a shortage of water, particularly as a result of there being insufficient rainfall. Agriculture is seen as the production of food crops and the rearing of farm animals to feed humankind and agricultural activities are dependent on water (Stubbs, 2015).

Worldwide, in 2012, over 324 million hectares were equipped for irrigation, of which about 85% or 275 million ha were irrigated. Irrigated agriculture represents 20% of the total cultivated land, but contributes 40% of the total food produced worldwide (Food and Agriculture Organization, 2014). The importance of irrigation globally cannot be underestimated, particularly for food crop production and livelihood improvement. Notwithstanding the present small irrigated land size in the world, irrigation farming makes available more than one-fifth of the world's food. Food security, non-farm businesses, income and employment, are examples of the importance and positive impacts of irrigation (Sebastian, 2014; Akudugu, Nyamadi, & Dittoh, 2016). Rain-fed agriculture is what dominates among smallholder farmers in Africa. As a result, smallholder farmers have their livelihood threatened because of the erratic rainfall pattern in Africa and climate change (Akudugu, Nyamadi, & Dittoh, 2016).

Although irrigation in Africa has a greater potential to boost agricultural productivities by at least 50%, food production on the continent is nearly entirely rainfed. Only 6% of the continent's farmland is irrigated compared to 37% in Asia. As a result, crops in Africa rely on rain despite irregular and insufficient rainfall, frequent drought, and the existence of ample, untapped water resources (You, Ringler, Nelson, Wood-Sichra, Robertson, Wood, Guo, Zhu, & Sun, 2010).

Ghana, just like most sub-Sahara countries in West Africa, is an agrarian economy which is largely dependent on rainfed agriculture. The agricultural sector in most African countries especially Ghana serves as the main livelihood of rural people and employs the largest proportion of the workforce (Moyo, 2006). About 60% of the total employment is in the agriculture sector, and the sector contributes about 19% of Gross Domestic Product in Ghana (Ghana Statistical Service, 2018). It is estimated that Gross Domestic Product growth originating from agriculture has more impact on poverty reduction than growth in any other economic sector (Ghana Statistical Service, 2018). Agricultural production and growth are largely transformative and leads to raised farmers' incomes, lower food prices, increased demand for industrial goods, low inflation, increased employment opportunities for unskilled labour, increased entrepreneurial activities, growth of rural service sectors and the emergence of agro-processing industries (Ghana Statistical Service, 2018; Dogan 2018). In many developing countries, the informal and agricultural sectors are very significant for human capital (Doğan, 2018). An estimated nine out of ten people source their livelihood from agriculture (Diao, Fan, Headey, Johnson, Pratt, & Yu, 2008; Ghana Statistical Service, 2015).

Wa West district is an agrarian community, which largely depends on water for the thriving of its main economic activity and livelihood. Small-scale irrigation farming is one definite way of reducing if not eradicating the redundancy of the labour force in the long dry season, providing room for food security and improvement of the livelihood of its inhabitants who are mostly farmers (Wa West District Assembly, 2014).

It has an irrigated land area of 139ha, and it is the district with the highest incidence of poverty pegged at 92.4%, and Upper West Region of Ghana also has its at 70.9% (Ministry of Food and Agriculture, n.d.; Ghana Statistical Service, 2018). Irrigation is an important strategy for addressing the poverty situation in the Wa West District in the face of the increasingly unreliable nature of rains. The existence of irrigation dams in the district provides the opportunity for all-year-round farming, potentially increased production and could offer smallholder farmers permanent employment throughout the year.

1.1 Problem statement

The benefits of irrigation to agricultural production are immense. Although there is considerable potential for development and the premium placed on irrigation development in many plans, it is rather unfortunate that less than 2% of the total area of cultivatable land in Ghana are irrigated (Namara, Horowitz, Nyamadi, & Barry, 2011). Sub-Saharan Africa tends to suffer more from the adversities associated with climate change and variability. Considering how uncertain it is to know when rainfall starts, increased temperatures among others tend to affect a lot of people's livelihood (Dube, Moyo, Ncube, & Nyath, 2016). The level of uncertainty concerning the onset of rainfall, the erratic rainfall pattern and increased temperatures have dire

consequences on agricultural-related livelihoods and energy (Dube et al., 2016); Environmental Protection Agency, EPA, 2016). Agriculture remains the most climate-sensitive sector, and most of the people engaged in agriculture in Ghana are small-scale peasant farmers (Ghana Statistical Service, 2012). The Northern part of Ghana tends to be a more vulnerable area insofar as climate change is concerned (Antwi-agyei, Dougill, Stringer, & Ardey, 2017).

Kyere (2016) corroborates the Environmental Protection Agency's assertion with the fact that farming to produce adequate foodstuffs is challenged with erratic rainfall pattern, poor farming practices, short farming season among others especially in the northern part of Ghana. Kyere continued that, the situation impels farmers to make no or little farm produce, especially in the dry season, which increases poverty among these rural farmers. The Wa West District of the Upper West Region is located along the Black Volta with its tributaries being the main drainage system and this presents the opportunity that can promote all-year farming (Wa West District Assembly, 2014).

Agriculture is the mainstay of the people of Wa West District and erratic rainfall and the short farming season adversely affects farming, leading to migration, especially of the youth (Wa West District Assembly, 2014). According to GSS (2010), the out-migrants in the Upper West region was 252,841 while the in-migrants was 43,427. According to Ghana's 2010 population and housing census, the north-western part of Ghana, including Wa West District, has the highest migration propensities, with out-migration ranging from 40% to 60% (Van Der Geest, 2011). As a result of that, the District had to take advantage of the perennial water supply of the Black Volta to continue with agricultural activities in the dry season. That led to the development of

irrigation systems from its feeder tributaries and the available underground water; as well as rainwater harvesting (Ghana Statistical Service, 2014).

According to Fielmua and Mwingyine (2018), many development partners are coming up with strategic ways of dealing with poverty which is a challenge in many developing countries and the provision of water services is one such way. Government and other stakeholders have endeavoured to construct dams and dugouts to present opportunities for irrigation. Notwithstanding these interventions, the district is rated as the poorest in the region with a poverty incidence of 92.4% and Upper West region with 70.9%, which is the highest in Ghana. This means that Wa West district is the poorest district in the poorest region of Ghana (Ghana Statistical Service, 2015). About 91.6% of households in the Wa West District depended on agriculture. There were 92.4% people out of a household population of 80,382 who were below the poverty line of GHS 1,314 in the Wa West district (Ghana Statistical Service, 2015). There are irrigation facilities in the district and literature (Lipton, Litchfield, & Faures, 2003; Zeweld, Huylenbroeck, Hidgot, Chandrakanth, & Speelman, 2015; Mengistie & Kidane, 2016; Acheampong, Balana, Nimoh, & Abaidoo, 2018) shows that irrigation facilities are meant to reduce poverty or enhance livelihood. There is paucity of literature to ascertain irrigation farmers' poverty situation in Wa West because of the advantage they have to farm all year round. The research seeks to investigate irrigation farmers to know how their activities are governed and whether they are able to use the irrigation to make sustainable livelihood since they have access to water throughout the year. Also, since migration according to the Wa West District (2014) is dominant, does it affect irrigation farmers considering the fact that irrigation farming, according to Dinye (2013) leads to the decline in the movement of the youth out to urban areas in the southern parts of

Ghana in search of greener pastures.?

1.2 Research Questions

1.2.1 Main research question

The main research question for the study is: What are the effects of irrigation farming on rural livelihood in the Wa West District?

1.2.2 Specific research questions

1. What are the structures that govern irrigation, and how do they affect irrigation?
2. How does irrigation farming contribute to enhancing farmers' livelihood?
3. What is the relationship between irrigation farming and migration?

1.3 Research Objectives

The main objective of this research is to examine the effects of irrigation farming on rural livelihood in the district.

The specific objectives include:

1. To identify the governing structures and how they affect irrigation.
2. To assess the contribution of irrigation farming to farmers' livelihood.
3. To examine the relationship between irrigation farming and migration.

1.4 Scope of the Study

The study was limited to Wa West district because it is an agrarian community and one of the districts with a high number of irrigation facilities and the poorest in the Upper West region.

Contextually, the purpose of this study assessed the contribution of irrigation farming to making a living and outlined some challenges that hinder the governance of the irrigation dams in Wa West district from which appropriate recommendations were made.

1.5 Significance of the research

Agriculture remains pivotal to the economy of the country. The current thinking all over the world is that irrigational dam schemes if well executed will revolutionize the agriculture potentials of the beneficiary communities as it offers the prospect for food self-sufficiency and security at both the household level and at the national level respectively. This is because irrigated lands are known to be twice as productive as rain-fed cropland (FAO, 1996). Livelihoods are immediately and directly impacted, and smallholder agriculture is transformed through output levels. Total output levels of irrigation can be increased in three ways. Irrigation makes water supply continuous and erratic rainfall would have minimal to no impact on crop losses. Also, there would be continuous cropping since there is water to supply to the plants which would invariably lead to an increase in farm output if all other things are held constant. Last but not least, it provides water for areas without water; hence there could be intensive farming activities undertaken there. When complementary inputs like viable seeds, fertilisers, modern technology, are used on fertile lands then irrigation leads to increases in the levels of output (Moyo, 2006; Akudugu, Nyamadi, & Dittoh, 2016).

It is important to note that much has not been done to ascertain the interrelationship of these complementary inputs mentioned above and how they can affect the yield of the farmers. Provision of water for farming all the time is a giant step in agriculture. Still, the fertility of the land, the methods and farming practices, farming inputs and technology and people with the requisite expertise to assist the farmers in increasing their output are also very important. If these are not available or functioning, they may cause challenges to this giant step. Therefore, this study would provide empirical

evidence that would help the Ghana Irrigation Development Authority, the Ministry of Food and Agriculture (MOFA), the Wa West District, the farmers and other researchers.

The Ghana Irrigation Development Authority would be provided with evidence that would help in their policy decision and the situation of dams and other ancillary facilities that would make optimum utilization of irrigation systems in the district and other facilities in Ghana. Also, MOFA would know the sort of measures to take to help in addressing or making better decisions in terms of helping the farmers to increase their yield. In terms of policymaking, this study would help generate baseline data that could help in planning and monitoring purposes with regards to irrigation projects in the Wa West District of the Upper West Region. The output of this study could also serve as a source of information for other researchers and organizations involved in irrigation projects and other projects in Wa West District and Ghana as a whole.

Subsistence farmers continue to face numerous challenges, among which is the single maxima and erratic rainfall pattern, which leads to poor crop yield and low-income generation (Yazeed, 2016). This study would, therefore, come up with appropriate recommendations that could enable subsistence farmers and others in the district to efficiently and effectively use the facilities to help in the betterment of the livelihood of the farmers. Appropriate recommendations could help sustain the dam without jeopardizing the ability to use the dam for domestic and other purposes.

1.6 Limitations of the study

The major constraint to this study was respondents' availability. All respondents in this study had various activities they were undertaking. It was therefore difficult getting in touch with them for the data collection. Notwithstanding the initial challenges, the researcher was able to schedule times that were convenient for all parties.

Also, time was another hurdle the researcher had to deal with. The Mixed-method approach the researcher adopted meant transcribing records from interviews and Focus Group Discussions. This, coupled with administering questionnaires, consumed a lot of time. The research was, however, successfully done through perseverance and patience.

Last but not least challenge was getting enumerators who were had experience in data collection and had control over the languages spoken in the study area. It took quite some time before getting enumerators who fit in the researcher's criteria. They were trained on what was expected for the research and deployed for the exercise.

1.7 Organisation of the Thesis

Chapter one focuses on the introduction to the study comprising the background, the problem statement, the research questions and objectives, significance of the study, limitations of the study and how the thesis is organized. Chapter two constitutes literature review, theoretical and conceptual frameworks of the research. Chapter three is devoted to the study area, the methodology employed, which outlines the research design, sources of data, sampling techniques, data collection tools and techniques and data analysis. The results, discussions and major findings are presented in chapter four. The last chapter, which is five, focuses on conclusion and recommendations of the research.

CHAPTER TWO

A REVIEW OF SMALL-SCALE IRRIGATION AND ITS EFFECTS ON LIVELIHOOD

2.0 Introduction

This chapter covers the review of related literature of the study. Areas included in this chapter are the definition of key concepts; historical accounts of irrigation farming in Ghana irrigation; management and governance of irrigation farming in Ghana; policy dimension of irrigation in Ghana; irrigation and livelihood; irrigation and food crop production; irrigation and livestock production; seasonality of farming; irrigation and migration and challenges of irrigation farming. The chapter also includes theoretical and conceptual frameworks for the study.

2.1 Definition of Key Concepts

This section is devoted to the definition of basic concepts in the study. They are Irrigation and Livelihood.

2.1.1 Irrigation

Irrigation means adding a certain amount of water at a given location to meet the requirements of a crop growing at that location in quantities suitable to the growth stage of the crop. This may also mean adding water in amounts needed to get the soil to the required level of moisture before planting crops (URT, 2009). This is a process by which land precipitation can be sustained by providing farmland with water. In this situation, water can be obtained from flowing rivers for crop production, rainwater collection by building dams and reservoirs and pumping up from the ground (Teju, 2000).

According to the Food and Agriculture Organization (FAO) (1997), irrigation is an artificial means of supplying water to crops, designed to allow farming in arid regions and to mitigate the impact of drought in the semi-arid areas. Mutsvangwa and Doranalli (2006) have described irrigation as the cultivation of land through artificial use of water to ensure double cultivation as well as steady water supply in areas where rainfall is unreliable. Irrigation water is used to ensure that soil moisture is adequate to meet crop water needs and thereby reduce the water deficit as a plant growth-limiting factor (Van Averbeke, Denison & Mnkeni, 2011). From the above concepts, irrigation can be conceptualized as the application of water to the soil to provide the necessary moisture for plant growth with the primary objective of augmenting rainfall water supply.

2.1.2 Livelihood

According to Chambers and Conway (1992), livelihood includes people, their abilities and their means of living, including food, properties and income. According to them, livelihood has a tripartite relationship where people thrive by using their capacities to make tangible (resources and stores) and intangible (claims and access) efficient uses of their assets. Ellis (2000) also describes livelihood as the actions, properties, and access that decide the living gained by a person or household. What is similar between these meanings is people's willingness to participate in activities and own assets to guarantee better living conditions for themselves.

When describing the idea of livelihoods, Wallman (1984) provides a critical viewpoint. He claims that living is more than just seeking or making shelter, earning money and preparing food, or making a market place trade. It is equally essential to own knowledge

and articulate information. This means that livelihoods transcend the behaviours and assets that guarantee decent living conditions to include maintaining social relationships, affirming personal importance and community identity, and interrelating each of these tasks to the other. Putting all these together constitute livelihood. Chambers and Conway (1992) described that as ***Capabilities***. For Wallman (1984), living is a broader term that implies that social life is in layers and overlaps (both in the way people think about it and how it should be analyzed). This is an essential feature for analysing livelihood.

Comparatively, it could be observed that in conceptualising livelihood, key elements which include assets, activities and entitlements should not be left out. Assets are what communities possess which comprise natural resources like land and water; social assets such as community and family networks; political assets such as empowerment and access rights; and human assets such as education, knowledge and skills. Activities, generally refer to whether assets are used by people in a group to make a living. Activities that include the sale of goods and services, while entitlements talk of those that are connected to legal or customary rights, including access to common owned property.

2.2 Historical Accounts of Irrigation Farming

Irrigation is an ancient agricultural practice used widely by early civilizations, including the ancient Egyptians (Grove, 1989). Irrigation has been done all over the world for decades, and it started with traditional methods that supplied water for farming (Punnet, 1982). According to Troeh & Miller (1980), as early as 500BC Nile River floodwaters

made fertile lands which the Egyptians cultivated. Canal system was established around 3000BC, which transported water from the Nile to their fields. It came after the realization that repeated droughts had occurred in Egypt, and that many dry areas could not reserve enough food for the whole year. Extensive irrigation systems in parts of China, India and South-West Asia had also been developed by that time. Therefore, irrigation, according to Chazovachii (2012), has encouraged the growing of crops in arid areas to supplement food production. Every year, an increase in crop production has resulted in it being the attraction for countries to increase irrigated land. Recent years have seen an increase in irrigation use in semi-arid regions to promote farming.

Historical records in Ghana trace irrigated farming back to a little over a century. The first scheme was conceived by the government as part of the Winneba Water Supply Project (Smith, 1969) back then in 1920. According to Agodzo and Bobobee (1994), in the 1930s in South-Eastern Ghana, several types of shallow-tube well irrigation was identified. In the 1950s and early 1960s, some water schemes were built in Guinea, Sudan and the Coastal Savannah belts, which accounted for about 240 earth dams and dug-outs in the north and about 66 in the Ho-Keta plains in the south to provide water for domestic, livestock and dry-season farming purposes (Agodzo & Bobobee, 1994).

The first national irrigation project, Dawhenya, was initiated soon after independence in 1959 but available records show that the Asutsuare Irrigation Project was the first to be completed in 1967. While the records date irrigation in the country to about a century ago, it is clear that there is a more recent trend in widespread irrigation. The realization of the importance of irrigation as regards agricultural growth in Ghana can be traced

back to the 1960s. The fact evidences this; it was during this time that vital investment was made to revamp irrigation infrastructure in the Northern and Coastal Zones where deplorable conditions of drought prevailed (Baffour & Ofori Kyei, 2007).

2.3 Irrigation Management in Ghana

While irrigation on farms in Ghana began a little over a century ago, it was known that in the early 1880s, small-scale farmers began irrigation practices that were high above flood levels and put in between the lagoon and the sandbar that detached it from the Keta sea (Kyei-Baffour & Ofori, 2007). Intensive farming methods through irrigation, manuring and crop rotation had to be employed due to the natural environment in some areas of the country (Kyei-Baffour & Ofori, 2007; Smith, 1969). Intensive irrigation witnessed between the 1960s and 80s saw the creation of about 19,000 ha of irrigated land. This increased to 33,800 ha in 2007 (Namara, Horowitz, Nyamadi, & Barry, 2011).

According to Kyei-Baffour & Ofori (2007), the core managerial function is the general direction and coordination of the decision-making process, which also involves managing those elements that affect the activity of irrigation systems. This includes resources such as labour, capital and machinery, skills including technical, planning strategies and effective communication and also, staff motivation activities such as salary increments, bonuses, tangible and intangible incentives, promotions, safe work environment and recognition given to deserving staff for hard work. The performance of this role is the duty of GIDA. Nevertheless, as a quasi-governmental entity, GIDA must aim to be successful by maintaining strict control over its activities such as budget

and staffing, while maintaining sufficient technical skills across all departments. Some conditions must be met first to encourage proper management. These are:

- A well-designed irrigation system and also ensuring higher productivity on projects;
- An appropriate management structure;
- Setting up a consistent and well-defined management structures (e.g. detailed management procedures, job descriptions, information and monitoring systems);
- Staff recruitment structures, production levels and attractive salary packages;
- Sufficient financial support for continuous disbursement, either from central government and from water and other charges; and
- Policy and Decision-makers must give irrigation projects maximum priority at the highest political level.

Management of irrigation system could be grouped into two in the Ghanaian perspective. These are formal systems and informal systems. While little is known about informal systems, due to easy access to reasonably cheap pumping technologies and readily accessible horticultural crop markets, they are growing at a faster pace (Namara et al., 2011). As the name suggests, the formal irrigation schemes are capital-intensive. They are usually performed by the Ghana government and its development partners from the initial phase of the projects until the end. The formal irrigation schemes are operated by the Ghana Irrigation Development Authority (GIDA) founded in April 1977 by Decree 85 of the Supreme Military Council (SMC) (FAO, 1985; MOFA, 2006). To pursue the promotion of agricultural growth through agricultural water management and irrigation, the Ghana Irrigation Development Authority as a

public sector organisation was established (Glitse, Nyamadi, Darkwah, & Mintah, 2017). It is GIDA's mandate to see to water management, undertaking civil engineering, supervision of irrigation facilities, and provision of aquaculture services to both individuals and the public. Aside from the activities of GIDA prescribed by law, which is managing and regulating public irrigation schemes, it is also supposed to promote the establishment and regulation of Water Users Association all over the country (GIDA, 2016a).

Also, there is an existing cordial and good working relationship between GIDA and Development Partners that make financial and technical provisions towards the construction of small-scale irrigation facilities (Glitse, P., Nyamadi, B. V., Mintah, K. A. & Feruta-Benee, 2018). According to the Decree which was later amended in 1987, GIDA 's responsibilities are:

- To draft irrigation plans;
- To develop comprehensive programs for the productive use of irrigated lands in collaboration with other organizations involved in providing farmers with extension services;
- To perform land use planning in development-assigned areas to protect soil and water supplies in those regions;
- To design the surroundings of each project area for housing and other social services;
- To work with other agencies to ensure the health and welfare of all persons living inside and around irrigation project areas;

- To perform specific tasks which are incidental or conducive to the fulfilment of its functions;
- To develop irrigated farming, livestock watering and aquaculture water supplies in the country;

These schemes could range from a few hectares to hundreds of hectares; hence government developed schemes to cover small, medium and large scale. Out of the total irrigated land, it is estimated that a little below 9,000 ha was developed by Government of Ghana (GoG) with the remaining land developed by the private sector (Namara et al., 2011). Major stakeholders such as farmers, government (MMDAs, GIDA, MoFA), policymakers, research institutions and non-governmental organizations must make contributions on efforts to restore irrigation structures, enhance input availability, make credit accessible and improve extension services. These would help to speed up the development of already existing schemes in the region (Segtub, Geophrey, Anornu, & Ofosu, 2018).

Studies have established that a lot of medium to large irrigation schemes developed by the government have failed (Dittoh, 1991; Sarris & Shams, 1991; Musa, 1992). In Ghana, an assessment of twenty-two irrigation schemes owned by the government indicated that most of them are not performing up to expectation (Dittoh, Lefore, & Ayantunde, 2014; Kyei-Baffour & Ofori, 2007). It is further revealed that schemes owned by the public appear not to favour small-scale poor farmers (Pant, 2004).

Informal or traditional systems are initiated and developed by private entrepreneurs and farmers. These systems instead seem to be doing well in terms of the irrigated land yield

obtained than the formal systems. In Ghana, it has been estimated that the areas under traditional irrigation are five times more than the formal irrigation systems (Dittoh et al., 2014). According to Nanes (2011), the area under traditional irrigation is far higher than what has been estimated. These forms of irrigation include groundwater or shallow well irrigation, tube-well irrigation, small pump irrigation and out-growers' systems. The use of pumps to irrigate from surface waters is becoming popular among farmers in almost all of Ghana's regional capitals (Namara et al., 2011). It was on record that 80 to 90% of Ghana's irrigation is smallholder based (Dittoh & Akuriba, 2012). Unlike formal irrigation systems, which seem to be primarily designed for rice production, the major crops grown under informal irrigation systems are horticultural. However, some staple crops such as maize, rice and cassava are cultivated either solely or in association with vegetables (Kyei-Baffour & Ofori, 2007).

Böcher (2012) stated that developing nations had accepted decentralisation as a means through which equity can be increased and usage of efficient and sustainable measures in the governance of natural resources which includes water. Basin level negotiations and coordination, regulations on cost recovery, assigning some aspects of irrigation management to local user Associations and water permits have aided water management (Maganga, Kiwasila, Juma, & Butterworth, 2004; URT, 2013). This led to the establishment of Water User Groups, which are overseen by GIDA. These groups elect officials and form various committees that help in the management of irrigation at the local levels. Braimah, King, & Sulemana, (2014), conducted a study in Bontanga and Golinga and it revealed that there were maintenance, finance, marketing and women's committees with various functions and all these committees work together to promote the irrigator's shared responsibilities regarding operations and maintenance.

Water User Groups are in charge of small-scale irrigations in the northern part of Ghana. It is the collective action of these groups that sees to the maintenance of the schemes (Kaiyatsa, Bai, Schneider, Herforth, & Masters, 2019).

According to a study by Mosha, Kajembe, Tarimo, Vedeld, & Mbeyale (2016), permits are granted to irrigators who are willing to pay water fees after they have harvested their produce. Irrigators in the Kilombero schemes are permitted to do irrigation all year round. There are sanctions, conditions necessary for membership, bylaws and a cost recovery system which serves as the guiding principles for water allocation and distribution. These bylaws, however, differ from district to district. Aside from these bylaws, some norms prohibit farmers and community members from washing or bathing in the irrigation canals. There is the existence of an informal structure which enforces rules that have been created by itself. Conflicts are resolved by respected elders within the clans and villages. The significance of the informal structure cannot be downplayed insofar as regulating the behaviours of irrigators for efficient and effective resource usage. The vibrant mix of newly formed and existing administrative entities help in the facilitation of land allocation and the proper distribution and use of water. The Rufiji River Basin Water Offices at the basin level is in charge for monitoring the water resources, identification of water users, water rights and bills issuance and the mediation of conflicts relative to water in its jurisdiction (Mosha et al., 2016).

In support of the above, Kurian and Dietz (2005) and Fujile, Hayami & Kikuchi (2005) stated in their studies in Harayana-India and Philippines respectively that operational rules have positive impacts on the management of water and conservation of resources.

This helps irrigation schemes that have diverse local water users in both the short and long terms.

2.4 Policy Dimension of Irrigation in Ghana

Food and Agriculture Sector Development Policy (FASDEP I) was implemented in 2002, and subsequently, FASDEP II tackled FASDEP I gap and inefficiencies (Drechsel, Obuobie, Adam-Bradford, & Cofie, 2014). Agricultural policy priorities for the food and agriculture sector include improving food security and readiness, increasing employment, improving competitiveness and enhancing integration in domestic and foreign markets, managing land resources and the environment at large, using scientific and technical approaches in the production of food and agriculture and improving institutional coordination

The cabinet approved the National Irrigation Policy in 2010, which was introduced in 2011 (MOFA, 2011). The policy's goal is to improve sustainable growth and irrigation efficiency. The policy covers constraints and incentives in all irrigation sub-sectors, including informal, formal and commercial irrigation. The policy also made it clear that the Food and Agriculture Ministry (MoFA) and the Ghana Irrigation Development Authority (GIDA) cannot function in isolation because agricultural water management is complex and cannot be regulated by one agency. Accordingly, GIDA encourages agencies and organizations such as regulatory bodies, local government, NGOs to cooperate with or collaborate with them for successful irrigation management. GIDA is a MoFA sub-sector responsible for irrigation management in Ghana and manages both public and private irrigation promotion.

There are effects of the National Water Policy to irrigation development (GoG, 2007). Under the new policy, the Government of Ghana is to ensure that there are adequate quantity and quality of water available to farmers for growing crops (Drechsel et al., 2014). The Ghana Government also established the National Land Policy in 1999 with a view to the sustainable use of Ghana 's national land and its natural resources (GoG, 1999). The policy promotes the developmental practices conducted according to the ideals of sustainable resource management and the environment. The policy requires that both large-scale and small-scale irrigation schemes comply with State Lands Act requirements (GoG, 1999).

GIDA has constructed 22 public irrigation schemes in Ghana (see Table 2.1), covering approximately 14,700 ha, of which 60 per cent was created in 2003 (MOFA, 2011). There are currently 56 GIDA and farmers-run irrigation schemes. The bulk of the schemes were initially operated by GIDA and Upper East Region Irrigation Company (ICOUR) in the northern region of Ghana.

Table 2.1: Irrigation Methods across Notable Public Irrigation Schemes in Ghana

Mode of Irrigation	Name of Scheme
1. Run-off-river diversion and gravity-fed systems	Sata, Annum Valley
2. River pumping-based and gravity-fed systems	Aveyime, Kikam
3. Reservoir-based gravity-fed systems	Libga, Afife, Bontanga, Gollinga, Tono, Vea, Ashaiman, Kpong, Okyereko
4. Reservoir pumping-based gravity-fed systems	Dawhenya
5. Lake pumping-based sprinkler irrigation systems	Weija, Kpando-Trokor, Amate, Dedeso
6. River pumping-based sprinkler irrigation systems	Subinja, Tanoso, Akumadan
7.Reservoir pumping-based sprinkler irrigation systems	Mankessim

Source: Namara et al., 2011 as cited in Mensah & Ibrahim, 2017.

Table 2.1 shows 22 public irrigation schemes in Ghana and the irrigation methods they use. Many small-scale irrigations are practised throughout the length and breadth of the country apart from public irrigation schemes. It is estimated that private small-scale irrigated land is about 1,850,000 ha, of which about 500,000 farmers are actively involved (Giordano, de Fraiture, Weight, & Van der Bliek, 2012). Private small-scale farmers work on farms of small size and use basic tools like cutlasses, buckets, knives and hoes.

2.5 Irrigation Farming in context

Irrigated farming accounts for 20 per cent of the total agricultural land, but contributes 40 per cent of the overall worldwide food production. Sub-Saharan Africa is the region with the lowest irrigated portion of the cultivated area, just over 3 per cent compared to nearly 21 per cent globally. At the same time, it has the highest undernourishment rate, 25 per cent in 2011-2013 compared to 12 per cent at the global level. The greatest potential for increasing irrigated agriculture, taking into account both land and water

resources, is in the region of Sub-Saharan Africa and South America. In Sub-saharan Africa, one-fifth of the irrigation potential has been equipped, or 7.7 million ha out of 38 million ha. In South America, one-fourth of the potential has been equipped, or 16 million ha out of the potential 60 million hectares (FAO, 2014).

Therefore, irrigation plays a less critical role in African agriculture compared to other countries, because the irrigated cultivated land of Africa is much lower than the world's average. It is suggested that the abysmal performance of Africa in terms of poverty reduction may be attributed to its less reliance on irrigation farming in no small extent. Approximately 6% of cultivated land is irrigated in Africa, compared to 37% in Asia and 14% in Latin America (You, Ringler, Nelson, Wood-Sichra, Robertson, Wood, Zhu, T... Sun, 2010). Differences in irrigation access across regions, countries are an essential factor in deciding poverty reduction levels since Asia has experienced substantial poverty reduction, while poverty has increased in Africa (Faurès and Santini, 2008; Bacha, Namara, Bogale, & Tesfaye, 2011).

Low irrigation levels in Africa are the product of high investment costs for irrigation, perceived shortcomings in past irrigation schemes, insufficient government support, weak rural infrastructure, fragmented farmers, and low-water crops (Inocencio, Kikuchi, Tonosaki, Maruyama, Merrey, Sally, & de Jong, 2007; You et al., 2010). Wealthy farmers are the ones who have greater access to irrigation technologies, according to Namara et al. (2014). In literature, it is commonly accepted that the Asian Green Revolution could not have occurred without irrigation investments (Lipton, Litchfield, & Faures, 2003; Turral, Svendsen, & Faures, 2010). Irrigation was an

essential element of the Green Revolution package, which raised not only large numbers of rural Asians out of poverty but also produced economic development-friendly conditions. Similar development techniques were proposed for Africa, which was used in Asian countries. This is so provided that the irrigation growth potential for Africa is enormous (Innocencio et al., 2007; You et al., 2010). Chazovachii (2012), revealed in a study that, majority of the respondents' engagement in an irrigation project allowed them to take their wards to school, take care of the medical expenses and improve the nutritional needs of their families. Women respondents acknowledged that they also earn some income though limited. This is corroborated by the Food and Agriculture Organisation, (2014) that, irrigation farming is proven to have a significant role in increasing income. Many countries in Sub-Saharan Africa, Ghana included, have realized the vital role of irrigation in food production, and irrigation investments have increased in the region. You et al. (2010) reported that, over the past 30 years, the average rate of expansion of irrigated areas in Africa was 2.3%. Despite some notable irrigation expansion, the developmental impact of irrigation in Africa has been limited and below expectations (Innocencio et al., 2007; García-Bolanos, Poblador, Dia, Seyid, & Mateosa, 2011). Farmers in northern Ghana focus a lot on yield and often overlook good agronomic practices that can help them to get the yields while maintaining the sustainability of the irrigation facilities (Agula, Mabe, Akudugu, Dittoh, Ayambila, & Bawah, 2019).

Notwithstanding the benefits of irrigation, Anang, Bäckman, & Sipiläinen, (2019) assert that the level of education among smallholder farmers in Northern Ghana is low and therefore has the tendency of affecting farm production and adoption of technology. Umar (2012) also revealed that, among irrigation farmers in Katsina State, farmers who

were 55 years and above possessed enough experience that helped them in their farming to yield more. Also, Lawal (2017) established that the marital status of irrigation farmers led to high productivity among married farmers because they have bigger households than the single farmers; therefore the need to provide more food.

2.5 Irrigation and Livelihood

Irrigation and livelihoods are inextricably linked. Irrigation schemes have proved a viable and attractive choice for rural farmers in developing countries. Returns from irrigated farming could well surpass the profits from rain-fed production, even on tiny plots. Irrigation schemes were counted in many developing countries for rising growth, reducing unpredictable rainfall drought, providing poor farmers with food security and jobs. Irrigation schemes are used as income-generating activities in some circumstances by supplying water at a cost to farmers (Cornish, Mensah, & Ghesquiere, 1999). Through this, farmers can produce yields throughout the year that provide them with income to meet some of their basic needs. According to Kundhande, Groenewald, Baiphethi, and Viljoen (1994), food output from irrigated farms is a significant source of wealth development insofar as it is the basis of economic growth in several localities.

Developments in irrigation have allowed the growth of other rural infrastructure in areas that otherwise might have been left without highways, telephones, schools and clinics. According to a study in Northern Ethiopia, results indicated the existence between the treated and control households of a statistically significant difference in wages, total spending, asset accumulation and spending on agricultural inputs. Notwithstanding that, there was no statistically significant difference between livestock income, food intake, and expenditure on education and health. This concludes that

involvement in small-scale irrigation has a substantial and positive impact on most livelihood indices and that expanding irrigation schemes is a good strategy in Ethiopia's water-stressed and drought-prone regions (Zeweld, Huylenbroeck, Hidgot, Chandrakanth, & Speelman, 2015).

A study was conducted to assess the effect of small-scale irrigation in achieving household livelihood development, and the major challenges of small-scale irrigation practices in the district of Gubalafto. It revealed that small-scale irrigation has a significant effect directly and in-directly on improving farmers' livelihoods in various ways, which include crop diversification, as well as increased agricultural growth, household income, job opportunities and community decision-making involvement. It has been proven that the annual average income of sampled irrigator households has increased. Ethiopia was severely affected by drought and climate-related hazards, and every year millions of people were left without food. Small-scale irrigation schemes were implemented as an alternative for productivity and diversifying livelihood scenarios (Mengistie & Kidane, 2016). With rural households creating jobs, increasing food security, stabilizing food prices on both the rural and urban markets, irrigation can reduce poverty and boost livelihoods (Lipton et al., 2003).

Carney (1999), identified various types of assets that contribute to the livelihoods of farmers, especially smallholders. These include;

- Physical assets which are production equipment (which include hoe, plough, cutlasses), basic infrastructure, e.g. shelter, roads, water, energy, communications)

- Natural assets which may include land, water, wildlife, biodiversity, environmental resources;
- Human assets which include skills, health, availability of labour
- Social assets which include membership of groups, access to institutions of society, networks, a relationship of trust
- Capital assets involving savings, credit, remittances, pensions

According to Rao (2006). There are primary mechanisms (strategies) to deal with their vulnerability and conditions under poverty. These include:

- Backyard gardening (both rural and urban)
- Fishing, mining, charcoal burning, quarry, small scale mining
- Livestock Production
- Conveying of goods by horse and donkeys, and head porting
- Seasonal migration for menial jobs
- Dry season farming
- Agro-processing, e.g. pito brewing, milling, shea butter processing

2.6 Irrigation and Food Crop Production

The rainfall pattern in sub-Saharan Africa is characterized by large scale intraseasonal and interannual variability. It causes frequent extreme weather events such as droughts and floods that reduce agricultural outputs. It can result in severe food shortages (Hoscilo, Balzter, Bartholomé, Boschetti, Brivio, Brink, …Pekel, 2014). Consequently, in most communities, farmers have adopted agricultural interventions including irrigation systems to improve household food availability and dietary diversity since over-dependence on erratic rainfall pattern is not helpful to agriculture (Inocencio et

al., 2007). Boafo, Saito, & Takeuchi (2014), established in Wa West District and Tolon that, about 80% of households that took part in the study primarily depended on ecosystem services like irrigation for sustenance. The challenges faced particularly by the long dry season among rural households have led to their engagement in irrigation. What necessitates this intervention stems from the fact that these interventions are plausible solutions that reduce poverty, build resilience to climate change, and improve food security (Scherr, Courtney & Buck, 2010; Balogun, 2011; Premanandh, 2011). Several studies have unearthed the influence of irrigation on food production (Alaofe, Burney, Naylor, & Douglas Taren, 2016).

Alaofe et al. (2016) evaluated the impact of Solar Market Gardens (SMGs) on crops production diversity and dietary diversity in the Kalal´e district of Northern Benin. They realised that the proportion of Small Market Gardening (SMG) women's group households engaged in vegetable and fruit production significantly increased by 26% and 55% respectively. This corresponded to their fruit and vegetable consumption. In their further analysis, they found that SMG women's groups were three times more likely to increase their fruit and vegetable consumption compared with non-women's groups. This implies that the adoption of irrigation system is a win-win solution which tackles food production, minimise hunger and maximise fruit and vegetable consumption which overall improves the nutritional status of households.

In some situations, the adoption of irrigation system also has a spillover effect on income and household food security. Adebayo, Bolarin, Oyewale and Kehinde, (2018) using household survey data from a sample of about 2305 households selected from eighteen states in Nigeria, analysed the impact of irrigation technology usage on crop

yield, crop income and household food security in Nigeria among smallholder farmers. Applying linear regression with endogenous treatment effects, they noted that irrigation technology use is positively related to crop yield, crop income and household food security. In their impact analysis conducted using propensity score matching (PSM) also showed a significant and positive effect of irrigation technology use on crop yield, crop income and household food security.

As observed by Dananto and Alemu (2014), irrigated agriculture is one of the components of world food production, which has contributed significantly to maintaining world food security and to the reduction of poverty, especially among rural households. Smith (2004) also noted that irrigation enables the farmer to control the available water throughout the growing season, which boosts productivity and reduces exposure to water shortfalls or seasonal droughts. Though it appears irrigation impact crop production, farmers need to be cautious not to over depend or overuse irrigation since counter results have been observed, which draws attention to soil type, irrigation and crop yield. In West Tennessee, Haghverdi, Leib, Washington-Allen, Wright, Ghodsi, Grant, Zheng, & Vanchiasong (2019) conducted a two-year on-farm irrigation experiment in a 73-ha cotton field. Variety of farming data were collected to understand the relationship between crop yields, the spatial heterogeneity of soil water content, and supplemental irrigation management. They noted that, generally, supplemental irrigation improved the cotton lint yield in comparison to rainfed throughout the two-year irrigation study.

In contrast, the yield response to supplemental irrigation differed across the soil types. Specifically, they observed that the yield increase due to irrigation was more

pronounced for coarse-textured soils. In contrast, a yield reduction was observed when higher irrigation water was applied to fine-textured soils. Even though soil nutrients levels are low in the Upper West Region, the content of clay is high in comparison to much of the soil in the region. It has a high ability to contain available plant nutrients for growth (Segtub, Geophrey, Anornu, & Ofosu, 2018).

The role of irrigation in increasing job opportunities and income has been studied and found significant (FAO, 2000). Furthermore, a study was undertaken by Bhandari and Pandey (2006) using farm-level data collected from 324 households in Nepal also indicated that shallow tube well irrigation had generated a significant positive effect in increasing the rice yields and overall farmers' incomes. On average, the yield of shallow tube well irrigation owners were increased by 86% when compared to that of rain-fed farmers. The net income of shallow tube well irrigation owners exceeds that of the rain-fed farmers by 69 USD per hectare, which has a noticeable effect on the ability of the farmers to reduce poverty and sustain their livelihood strategies. Irrigation can raise the incomes of those farmers with access to irrigated land where conditions are favourable. Lipton et al. (2003), found out that income in irrigated areas had increased across India, although not homogeneously.

2.7 Irrigation and Livestock Rearing

Livestock plays a significant role in human society and mixed farming in particular. In return, the animals produce numerous products, such as meat, milk, eggs and income, while dung and urine are useful for fertilizing gardens and fields (Schiere & Kater, 2001). Several benefits can be obtained from the integration of animals with other components of the agricultural system. For example, manure, which is an essential component of livestock production (Harris, 1998), can contribute as much as 35% of

organic soil matter (Steinfeld, Gerber, Wassenaar, Castel, Rosales, & de Haan 2006). Farmers throughout semi-arid Africa use manure for crop production, save crop residues for feed, and cultivate and transport with animals (McIntire, Bourzat, & Pingali, 1992). In addition to its annual revenue from field crops, livestock may also guarantee the farmer a regular source of income. Increased animal production will boost the income status of low-income farmers and women, thereby reducing malnutrition (Singh, 2001).

As such, expert advice reinforces that, if farmers integrate livestock to their farming practices, they could yield better results. Elzaki, Elfaki, Elobied & Ahmed (2011), analysed the prospects of merging irrigation farming and livestock production in Sudan. From the analysis, it was found that significant improvements in farm yields, suggesting that fodder production will be profitable. They also found that income for farmers would be increased, either directly through fodder returns or indirectly through the rise in livestock products. A study by Acheampong, Balana, Nimoh, & Abaidoo (2018), showed that about 70% of respondents tend to benefit in multiple folds from the opportunities presented by irrigation through farming, a water source for livestock and domestic use. Also, there was a green pasture around the dam which provided feed for livestock. The primary livelihood benefits that were realised from the study amongst all the communities were dry season farming, aquaculture and source of drinking water for livestock.

2.8 Seasonality of Farming

Due to anthropogenic and other causes, climate change is becoming rapid. Climate change occurs when the average weather conditions of a region, especially in temperature and precipitation, radically shift (MacIver, 1998). This transition also

affects agricultural activities. Changing climate conditions for the better has thus been a critical component of environmental economists' research for the past decade, with focus on their effects on agriculture, water supplies, and economic growth (Chimeli, De Souza Filho, Holanda, & Petterini, 2008; Mendelsohn, Dinar, Williams, 2006).

Climate change has adversely affected water supplies and agriculture to a very significant degree. A prominent finding drawn in a study by Masters and Macmillan (2000), is that rising climatic conditions have higher propensity to worsen farmers' incomes in the tropics than in temperate regions. Seo, Mendelsohn, & Munasinghe (2005) quantified the effects of climate change on agriculture in their research on climate change impacts on the Sri Lankan agricultural sector using a Ricardian valuation model. Their findings showed a rise in temperature appears to result in a substantial decrease in the production of about 11 to 20 per cent. Water quality and availability for agricultural crop production are both influenced by shifting climatic conditions and warmer, drier conditions increasing mineralization of harmful heavy metals (Murdoch, Baron, & Miller, 2000). As a result, the supply of these metals to surface and groundwater bodies is growing and making it unhealthy for crop production. Climate change influences dams, reservoirs, dugouts, and other bodies of surface water. For example, in tropical regions, evaporation from rising temperatures causes drying of reservoirs, rendering water inaccessible for crop production (Nakuja, Sarpong, Kuwornu, & Asante, 2012).

As a result, effective adaptation is one way to successfully control the severity of climate change's effects on water resources. MacIver (1998) suggests that adaptation is

essential and constitutes a vital component of an integrated and sustainable climate variability response. Likewise, Nakuja et al. (2012) indicate that, concerning water management, climate adaptation means controlling or living in harmony with the scarce water supplies. It can be achieved by increasing water storage capacity, adjusting the planting dates to compensate for droughts, or controlling water prices for productive farm usage. Farmers in sub-Saharan Africa are improvising a multitude of strategies for adapting to the water scarcity. One example is the expansion of water storage facilities to store rainwater for dry season use (Nakuja et al., 2012). Climate change is reaching every corner of Ghana, especially among the northern regions. It has had common effects on farming systems that are resulting in adaptations by farmers. Uchendu and Anthony (1969) stressed that changes observed in cropping from one season to the next in Northern Ghana between the 1930s and 1960s had not been significant due to steady and consistent rainfall patterns. Some of the crops planted during this time include millet, sorghum, cowpea and other cereals except rice that is mostly planted during the first week of April to coincide with the first heavy rains that occurred in the area mainly during the first week of April.

However, Mensah-Bonsu (2003) indicated that crop planting periods in Northern Ghana have changed in recent years from early April in the 1960s to late April or early May. This is due to changes in climatic conditions as evidenced by the erratic nature of rainfall and the changing environmental conditions, especially rainfall and distribution. Similarly, the decline in soil fertility due to the loss of forest cover forced farmers in the region to start farming on compound land, which was primarily used for animal rearing (Wills, 1962). The unfavourable weather also caused farmers to sell livestock which farmers have historically reared for social opportunities to earn income to buy

food in times of crop failure (Agyepong, Gyasi, Nabila, & Kufogbe, 1999). It was after 1984 that farmers started planting indigenous trees (Gana, 1995). Together with bad agricultural practices such as cutting and burning and indiscriminate felling of trees for firewood, climate change caused the forest cover in the Upper East region to fall from 44 per cent in 1964 to 21 per cent in 1984. Then farmers in the area resorted to the planting of indigenous trees such as neem and mango (Gana, 1995).

Agriculture in Ghana during the dry season mainly relies on the collected water. In this system, rainwater is harvested for the cultivation of tomatoes, onions, sweet potato vines and leafy vegetables in the dry season. The predominant types of water storage systems used for dry season farming in the Upper East region are irrigation dams, dugouts and shallow wells (Nakuja et al., 2012). They further reported that about 70 per cent of Ghana's dugouts were found in the Upper East region as of 2007, and dugouts represented more than 80 per cent of the region 's water storage systems. Therefore, dugouts serve as the most commonly used agricultural water storage systems in the area.

2.9 Irrigation and Migration

Defining migration as a social phenomenon has been very difficult because of its complex dimensions. According to Ogden (1984), it is often simply defined relative to the geographical phenomenon, which, to some extent, is correct. Still, practically, migration as a social phenomenon becomes more difficult to define when some factors, including the different kinds of movement, the extent to which it occurs and difficulties over sources of their study. Despite these challenges, there is a need for a proper definition of this phenomenon to assign appropriate strategies to address it. Migration

is typically defined based on the destination and origin of the migrants. Timing, the reason for migrating and direction are some factors that are also considered in migration. There are different types of migration which include international migration, thus, moving from one country to the other, rural-rural migration, rural-urban migration, urban-rural migration and you urban-urban migration. Seasonal migration is a form of human migration which is related to timing. This migration is often associated with the change in the season where labour migrates for a temporary short-term. Ogden observed that movement from villages to large cities follows a step-by-step pattern. This means that rural folks moved to local towns, possibly to regional capitals and later to urban areas. This is a phenomenon known as step migration.

With the improvement in public transportation and information flow in recent times, people can move without following any pattern from rural to very distant urban areas. The sequence of migration of friends or household member to a particular location informs the migration of other people mostly to the same destinations. Migration could occur if the destination exerts some pull factors on a migrant if one sets out to search for opportunities to improve their livelihoods (Darkoh et al., 2003). Irrigation is a mechanised farming technique that has been opted to be among the best farming practices worldwide. This farming practise employs a host of labour, both skilled and unskilled which feed into total workforce employed by the agriculture sector. It is known that a cross-section of the economically active population, including migrants, are absorbed into the agricultural sector. However, disparities exist as one moves from developing countries to developed nations. The International Labour Organisation's Global Employment report for 2013 estimated that 1.1 billion or 34% of the world's workers were employed in agriculture (Martin, 2016). In developed economies with a

total workforce of 468 million, sectorial shares of employment were: 16 million or 4% in agriculture while out of 2.8 billion workforces in developing countries, 1 billion or 37% into agriculture (Martin, 2016). However, it is known that countries with fewer than 5% of their workforces employed in agriculture are rich, and all countries with more than 50% of workers employed in agriculture are considered poor (Martin, 2016).

Although migration, being it internal or external, will drift potential workforce from agriculture, agricultural communities employ the coping or adaptive method to sustain agricultural production. Current adaptation approaches include the transition to less labour-intensive ways of farming, such as less labour-intensive crops and mechanization (Jokisch, 2002). However, in situations of small localized plots, mechanization is inefficient-which is the case in most parts of Africa, causing the output of agricultural labour productivity to be below capacity (White, 2005).

Studies on migration and farming, in general, has produced mixed findings; hence conclusion cannot be made as to whether migration negatively affects agricultural production or otherwise. Also, the influence of migration on agriculture differs depending on the type of migration (permanent or temporary) involved. Adaku (2013) examined how rural-urban migration affects agricultural production at the origin (places they migrate from) in Ghana. Using the production method of Cobb Douglas and the two-stage least square regression model, the analysis revealed that households whose members engaged in temporary migration had significantly decreased farm production. In contrast, households whose members engaged in permanent migration had no significant impact on production.

Also focusing on the relationship between migration, remittances and agricultural development was an earlier study by Rozelle, Taylor, & de Brauw (1999). Their findings showed that the impact of migration on yields is significantly negative and that remittances are a positive explanation for migration. However, Jokisch's (2002) research involving an agricultural survey conducted in two Ecuadorian communities to assess the land-use and agricultural production of migrant and non-migrant households found contrary results. It was observed that migration had neither contributed to a decline in agricultural production nor committed remittances to improvements in agriculture. The result was that migrant households are not substantially different from non-migrant households in the use of land and agricultural production. Similarly, Cohen (2005) did not report any improvements in the output of agricultural households at the origin of migration despite receiving migrant remittances.

Irrigation and other capital-intensive farming require enough resources. Studies have revealed that simple relationship does exist between agriculture and migration partly because remittances received by relatives are sometimes invested in agriculture. That is, when the consumption and other spending needs of households have been completely met, the household will invest remittances in agriculture as well as increase productivity in the event of an extended migration duration (Cohen, 2005). Caution must, however, be applied when describing the impact of migration, remittances and agriculture because, in some cases, families spent remittances entirely on daily consumption.

Mendola's study (2008) aimed to find out whether migration had helped the rural household at the origin invest in new technologies. The study found that international migration had a positive impact on the investment of the household in new agricultural technologies; meanwhile, internal migration, including both transient and prolonged migration, has harmed agricultural investment and productivity. However, counter-findings were found by Turner, Hyden and Kates (1993), using a technique that uses "natural experiments". They examined changes in agricultural inputs and outputs and the role that external productive forces have played in these changes in exploring whether population growth in densely populated areas of rural Africa has led to agricultural intensification. Their findings showed that remittances are rarely used for agricultural investments, and there was also no tendency for migration to stagnate agricultural intensification.

Prevalence of movement out of the Upper West Region in the dry season for menial jobs is attributed to food insecurity and poverty (Segtub, Geophrey, Anornu, & Ofosu, 2018). Irrigation farming has led to the decline in the movement of the youth out to urban areas in the southern parts of Ghana in search of greener pastures. Notwithstanding this, the income accrued from irrigation farming as a result of its associated problems is not enough to decrease the out-flow of the youth in a significant proportion (Dinye, 2013).

2.10 Challenges to Irrigation

Broadly, irrigation farming in most parts of Ghana is widespread. Nevertheless, in the northern regions, it is highly concentrated (Dinye & Ayitio, 2013; Månsson, 2011; Drechsel, Obuobie, Adam-Bradford, & Cofie, 2014). Specifically, the two largest

irrigation schemes are located in the northern part of Ghana, named Tono and Vea irrigation schemes that provide the water required for farming to many farmers and increase their socio-economic sustainability activities (Mensah & Ibrahim, 2017). However, these irrigation farming operate with challenges.

Namara et al. (2011) looked into the growth of irrigation in Ghana, past experiences, potential prospects and future directions. They found that the problems facing irrigation in Ghana were financial incapacity, administrative issues, access to inputs and services, marketing and post-harvest handling, inadequate coordination and compensation disputes between government and landowners. The current report by Food and Agriculture Organisation International Finance Corporation in Ghana also indicated that financial constraints breed most of the challenges mentioned above (The International Finance Corporation, 2014). A study conducted by Abdulai (2018) in Northern Ghana revealed that local economic development, improvement in farm productivity and agriculture modernisation had been hampered in Ghana because of access to credit by smallholder irrigation farmers. Irrigated vegetable farmers put high cost of inputs as their biggest production constraint with as high as 81.8% who do not have any access to any form of credit, and the situation is more difficult with assessing credit from formal credit sources.

Appiah-Nkansah (2009) looked at the Upper West region's irrigation systems. He pointed out that irrigation in Ghana is fraught with problems ranging from poorly managed canals, weeds and mud covering networks of canals. In a related study, the Government was blamed for poor maintenance structures (Owusu, Nyantakyi, and Borkloe, 2013). However, the inability of the government to engage effectively in the

repair and provision of machinery service has contributed to devastating consequences. The government mainly provides the headwork, conveyance and distribution infrastructure for the country's irrigation development; therefore, if maintenance is left to farmers alone, it will be challenging given the current problems facing farmers such as low farm income and production (MOFA, 2011). That has contributed to some of the schemes being utterly ignored, resulting in a complete breakdown. The abysmal performance of small-scale irrigation schemes can be attributed to the Upper West region lacking access to vital inputs and credits such as ready and available markets, extension services and mechanized labour. Water and land are also recognized in the study as major potentials for production if adequate farmer support and the appropriate technologies are made available (Segtub, Geophrey, Anornu, & Ofosu, 2018). They further asserted that, water structures, labour, inputs, extension services, fuel and market as the major challenges that constrain farmers in their production.

Technology adoption, production efficiency, consumption and asset growth are known to be positively influenced when farmers have access to credit (Obuobisa-Darko, 2015; Daniel, 2015; Duy, 2015). Notwithstanding the outlined benefits, lack of access to credit has been a significant challenge for smallholder irrigation farmers which has negatively impacted their access to modern inputs and technologies for irrigation. This means that the likelihood of smallholder farmers using low-level inputs which would adversely affect their productivity is high because of credit constraint. Farming operations and access to farm inputs which have a direct link to the adoption of irrigation technology can be improved through access to credit. Low crop yields can be linked with the inability to access credit to purchase and adopt some basic production

technologies (MOFA, 2010). Majority of smallholder farmers in northern Ghana put a premium on access to credit (Dittoh, 2006; Nouman, Siddiqi, Asim, & Hussain, 2013).

Cornish & Lawrence (2001) found that farmers still lack basic knowledge on areas such as land preparation, water management, crop production and sustainable irrigation methods, and this argument was also endorsed by IFC (2014) and Schraven (2010). This condition may, therefore, harm total crop production and on food consumption (Drechsel & Keraita, 2014). Also, information management and sharing are essential components of sustainable irrigated agriculture; however, the information and expertise required to manage irrigated agriculture effectively continue to fail to evolve (Asante, 2013; IFC, 2014). There is a shortage of computers needed to store essential farm information, and the available ones are either damaged or inconvenient to use. Therefore, details such as farm records, reports and paperwork will probably be written on paper and stored in shelves. Often, they are missing from the shelves, or almost torn apart because of old age.

More to the point, Atiim (2011) identified obsolete irrigation equipment and mechanization as inhibiting factors in Ghana 's sustainable irrigated agriculture, especially in northern Ghana. Modern farming method of irrigation is done in such a way as not to preserve the soil and the water. For example, in most parts of northern Ghana, illegal dug-outs pose significant health and environmental risks (Drechsel et al., 2014). Schraven (2010) recorded that farmers rely on rivers along farms as a source of water for irrigation, and dug wells on river beds. In the dry season, these activities decrease water levels and severely contaminate surface water due to the extensive penetration of fertilisers and pesticides into the soil.

Ghana has institutions such as the Environmental Protection Agency (EPA), water and sanitation regulatory bodies, and local authorities to ensure that the environment is safe but rarely deals with these situations. Other related studies endorse Schraven's argument about the effect of inadequate irrigation water management (Afrane & Ntiamoah, 2011; Anim-Gyampo, Zango, & Ampadu, 2014; Ansah-Asare & Asante, 2008). Most farmers are forced to rely on groundwater or shallow wells for water which increases the need for labour. This was realized from the field study survey where structures such as canals and laterals were in deplorable conditions rendering them difficult to transport adequate volumes of water to the fields in the Upper West Region. Furthermore, there is a lack of gates and appropriate sewage systems to control and channel run-offs in water schemes (Segtub, Geophrey, Anornu, & Ofosu, 2018).

Also, farmers face the challenge of expansion activities and limitations to subsistence farming due to the high cost of farming inputs like fertilizers, seeds, weedicides, tools and types of machinery, mainly pumping machines. This is mostly due to the inability of farmers to acquire loans from banks as a result of the absence of collaterals (Segtub, Geophrey, Anornu, & Ofosu, 2018). Farmers sell their crops directly in local markets to customers or through intermediaries who tend to exploit the farmers due to the lack of readily available market information. The absence of readily available market to sell much of their products leads to them perishing. As a result of the lack of storage facilities, customers determine prices of crops produced by farmers. Farmers who endeavour to avoid exploitation by intermediaries transport their produce to distant markets, experience low or no patronage due to the market being full of similar products (Dinye, 2013; Segtub, Geophrey, Anornu, & Ofosu, 2018).

There has been inadequate technical assistance provided by agricultural extension officers. This shortfall in needed support to farmers from technical officers' harms production and post-harvest activities. More than one-third that is 38.7% of farmers lack access to extension services due to this; farmers are challenged with diseases affecting crops, pest attacks and lack of knowledge on modern farm techniques (Dinye, 2013). Farmers attribute the failure of plants to diseases. This does not only affect their yield but also gets them demoralized and deters them from cultivating some crop varieties. Agricultural Extension Agents scarcely attend to farmers to identify the problems faced by farmers and to help them with the necessary solution (Moris & Thom, 1985). Main surface irrigation methods require adequate land preparation which is needed to ensure optimum water management. For instance, a levelled field has the potential of making optimum use of water and saving irrigation time. In this situation, when the water is opened for distribution on the land, each row and its plants get the right amount of water on rightly levelled land. This would eliminate drainage and moisture stress problems that may arise to affect the crops through drowning or burning from excess water or no water (Kyei-Baffour & Ofori, 2007). It could be argued that examining studies on challenges to irrigation; the issues can broadly be grouped into four: technical challenges arising from how irrigation dams, canals and scheme are constructed; Maintenance challenges; financial challenges and human resource challenges. This implies that a holistic approach needs to be adopted when dealing with challenges confronting irrigation agriculture in Ghana.

2.11 Theoretical and Conceptual Framework for the Study

Complex factors influence irrigation agriculture, livelihood strategies, policy actors and migration, which demands theoretical guidance. However, regardless of attempts that have been made to conceptualise sustainable livelihood in literature, Benson et al. (2007) observed that the concept is still evolving as an idea and a methodology. Coupled with that, agriculture as a whole forms part of the broader system which is affected by other systems such as governance, economy, education, culture and others.

Systems theory studies the whole system and relationship among its components. Biology and environmental science use its principles widely, as do other disciplines, including systems analysis (Walby, 2007). It is also applicable to almost any subject (Spedding, 1988) and it has been proven successful in analysis, management and improvement of existing systems (Cavallo, 1982), in agricultural (Ikerd, 1993) or rural development (Belshaw & Chambers, 1973). As a result, the Systems theory was considered for this study.

2.11.1 Systems Theory

Farming activities thrive well if the other structures, such as better agricultural policies work well. This implies that agricultural activities can be equated to the systemic theory, whereby the successful progression of the whole system depends on the functioning of sub-systems forming the system. According to Bailey (1994), the system's theory is the fundamental framework by which one can analyse, describe and predict the behaviour of any group that works in consent to produce a result. This could be a single organism, any organisation or society. The assumption is that every system that produces results is part of interlinked parts and therefore, every change that affects

one or more parts in the system causes the whole of it to change either positively or negatively. A system works well only when all parts are in harmony.

A system is a group of interacting components, operating together for a common purpose (Spedding, 1988). Checkland, the proponent of Soft System Methodology (Checkland, 1981) observed a system as a model of an entity, which is characterised in terms of its hierarchical structure, emergent properties, communication and control. The system approach proposes a way to understand that entity and negotiate its problems for improved performance. The theory is relevant to this study in that; farmers are surrounded by other factors such as policies, laws, the government, NGOs, families and others. When the existing policies favour farming, with remittances received from friends or family members, income generated from other sources, farmers can embark on larger mechanised irrigation farming. However, migration can also pull or push active labour force which can affect labour force needed for irrigation activities positively or otherwise. The study adopted system theory to ascertain how the various cogs in the irrigation machine work together for its effectiveness and the challenges they face considering the interconnected nature of factors for irrigation to be successful.

2.11.2 Social Capital theory

According to Lin (1999), social capital can be defined simply and in clear terms as the expected benefits that can be achieved from investing in social relationships and the benefits that can be accrued from such investment. Considering other definitions in the debates on social capital, he emphasized that his definition is in line with them (Bourdieu 1986; Coleman 1988). Loury (1977) emphasized the relationship between successes in life and the different forms of capital. He contended that our social

background depended significantly on the number of resources that are invested in development, for example, level of education.

In Coleman's theory of social capital, he grounded his theory in the context of the theory of rational choice. The interdependence among various actors in society occurs from the fact that the actors have an interest in events and resources that are controlled by other actors. This control tends to ensure optimum utilization through rational choices of best solutions. According to Coleman (1990), "social capital is defined by its function. It is not a single entity, but a variety of different entities having two characteristics in common. They all consist of some aspect of social structure, and they facilitate certain actions of individuals who are within the structure". This means that social capital is embedded in a social structure and the benefits members within the social structure reap, making it a significant resource.

Without social capital, certain ends would not be achievable, and with it, some ends are achievable. With the embedded actors or members, social capital is a public good, unlike physical and human capitals that are private goods. The latter benefits only those who invest in them but the former, being a public good also benefits actors who did not invest in it but form part of the social structure (Coleman, 1995). The social structure serves as a conduit for the establishments of actions deemed appropriate or inappropriate, and these are known as social norms. Members of the social structure through whom these norms were instituted and for that matter, support them, anticipate there would be benefits that would be reaped by actors if there is compliance. Coleman further asserted that, if the norms that regulate certain activities or actions within a social structure are defined socially as being right to control the activities or actions,

and it is the property of all actors then it exists. Sanctions and rewards typify norms through their enforcement (Coleman, 1994). For example, if farmers establish a norm that no one should farm along the banks of an irrigation dam, the negative externality of the dam filled with silt to reduce the water holding capacity would be reduced. In this situation, some people who do not do irrigation farming but use the water for other domestic purposes and fishing, may not have been part of the establishment of the norm but also benefit from it. This theory is therefore relevant to this study because irrigation farmers have the physical and human capital to support their livelihoods and need to harness their social capital to make the best out of their farming.

2.11.3 Sustainable Livelihood Approach

The use of sustainable livelihood approach as a theory among scholars in development has had varying views. This stems from the positions whether it can be regarded as a concept or otherwise. Regardless of the diverging views on this, some scholars are of the view the sustainable livelihood approach is a theory and therefore refers to it as the Sustainable Livelihood Theory. One scholar who holds this assertion is McLeod and is of the view that the sustainable livelihood approach helps poor people get leverage in the achievement of long-lasting and improved livelihood which could be measured using poverty reduction indicators. People's way of understanding livelihoods of deprived people is further enhanced by this approach (McLeod's, 2001). There is adequate comprehension of realities through enhanced programs which is made possible by a methodological framework which is created by the approach and also helps to appreciate the context of research of the study (Cortes, 2014).

In the context of this study, the approaches are used to understand the actions and inactions of small-scale irrigation farmers in their bid to achieving their livelihood resources. There is, therefore, an outcome which comes about that leads to poverty reduction as a result of the choices made on their livelihood assets. Despite this, the lengths small-scale farmers go to manage and recover from strain and pressure can offset or improve the livelihoods of these farmers and thus dictates the sustainability of their livelihoods.

The Sustainable Livelihood Approach has seen much condemnation because it is usually seen as the only way of organizing the complex issues of poverty even though the suitability of the approach to indigenous circumstances and priorities are yet to be assessed.

2.12 Conceptual Framework for the Study

Several international development agencies such as the United Nations Development Programme (UNDP), the Department for International Development (DFID), CARE International and OXFAM have adopted it in project appraisals and reviews. It is steadily becoming part of the mainstream of development planning. The DFID's Sustainable Livelihood Framework (see Figure 2.1) shall be used as the framework guiding the study.

2.12.1 The DFID's Sustainable Livelihood Framework (SLF)

Many livelihood studies have adopted and applied the DFID's SLF approach giving grounds for development studies, thinking, and research (Shankland, 2000; Arthur, Agyemang-Duah, Gyasi, Yeboah, & Otieku, 2016). This framework evolved from the

debates and discussions on sustainable livelihood, poverty reduction, and assets (Sen, 1987, World Commission on Environment and Development (WCED), 1987; Chambers & Conway, 1992; Carswell, 1997; Scoones, 1998) and the Brundtland Commission popularised it on Environment and Development in 1987. Later, the concept was expanded by the 1992 United Nations Conference on Environment and Development, which advocated for the achievement of sustainable livelihoods as a goal for poverty eradication (World Commission on Environment and Development (WCED), 1987).

The SLF focuses on people and their livelihoods and how people can use their assets to realize their basic needs of life and reduce poverty (Department for International Development, 2001; Ashley & Carney, 1999). The SLF has five main components that are interrelated and are: Vulnerability context (in terms of stress, shocks, and seasonality); Livelihood Assets; Transforming structures and processes; Livelihood strategies; and Livelihood outcomes. The SLF shows that sustainable livelihoods are achieved through access to a variety of livelihood sources such as natural capital (land) that are combined in the pursuit of livelihood strategies to realize livelihood outcomes (Ashley & Carney, 1999).

Livelihood strategies consist of a range and combination of activities and choices that people decide or undertake to achieve their livelihood goals. Livelihood strategies are dependent on asset endowments and policies, institutions, and processes in place (Department for International Development, 2001). The livelihood strategy that applies to this study is irrigation farming. The transforming structures and processes such as culture, laws, and policies in the framework are linked to the vulnerability context,

which in turn affects the livelihood assets available. Livelihood strategies such as irrigation farming with various transforming structures and processes such as laws, policies, and culture influence livelihood assets which in turn help to enhance or reduce people's assets in the community. The institutions, policies, and customs of the transforming structure and processes in the framework enhance or hinder people's access to an asset or resource such as natural capital (Department for International Development, 2001).

The livelihood outcomes in the framework are achieved as a result of livelihood strategies and are linked to livelihood assets to indicate how they enhance or increase them (Ashley & Carney, 1999). The assets in SLF show different forms of asset which people use to realize livelihood outcomes. The framework indicates that assets have five forms: natural, human, physical, financial, and social capital. DFID denotes assets as natural, physical, human, social, and financial capital. Assets are both created and destroyed as an upshot of trends, shocks, and seasonality of vulnerability context (Department for International Development, 2001). Assets' relationships with livelihood strategies illustrate that people with more assets tend to have a range of options and ability to move between multiple strategies to secure their livelihoods as well as achieve positive livelihood outcomes (Department for International Development, 2001).

The vulnerability context of DFID sustainable livelihood framework encompasses shocks, trends, and seasonality of livelihood strategies which in turn is linked to livelihood assets. It shows how it affects livelihood assets such as human capital and natural capital (Department for International Development, 2001; Ashley & Carney,

1999). The vulnerability context in the framework represents the external environment in which people exist. Trends, shocks, and seasonality are the factors over which people have limited or no control (Department for International Development, 2001). Scoones (1998) argues that the ability of livelihood to recover from stresses and shocks is key to sustainable livelihoods. The vulnerability context which entails the shocks and trends is interrelated to policies and institutions whose responsibility is to ensure that policies implemented to improve irrigation farming.

These two components in the framework are also directly linked to the livelihood or capital assets which are at the centre of the framework. Also, the capital assets are then linked to the livelihood strategies, which lead to diversifications and innovative practices put forward by smallholder farmers to obtain a certain livelihood outcome. In other words, these livelihood strategies consequently inform the kind of outcome that will be derived hence the livelihood outcome component. The livelihood outcome that would be generated can then be fed back into the capital assets, vulnerability context and the policies and institutional component in the framework to derive sustainable livelihood outcomes.

The usefulness of the sustainable livelihood framework to this study is that it focuses on livelihood outcomes, assets owned by people in their pursuit of livelihood strategies such as Irrigated agriculture and vulnerabilities exposed to people (Ashley & Carney, 1999) employing the SLF to the study output. This framework gives a better understanding and appreciation of the possible outcomes of irrigation activities on

livelihoods and to make induction whether irrigation activity could stimulate migration which in turn affects livelihood.

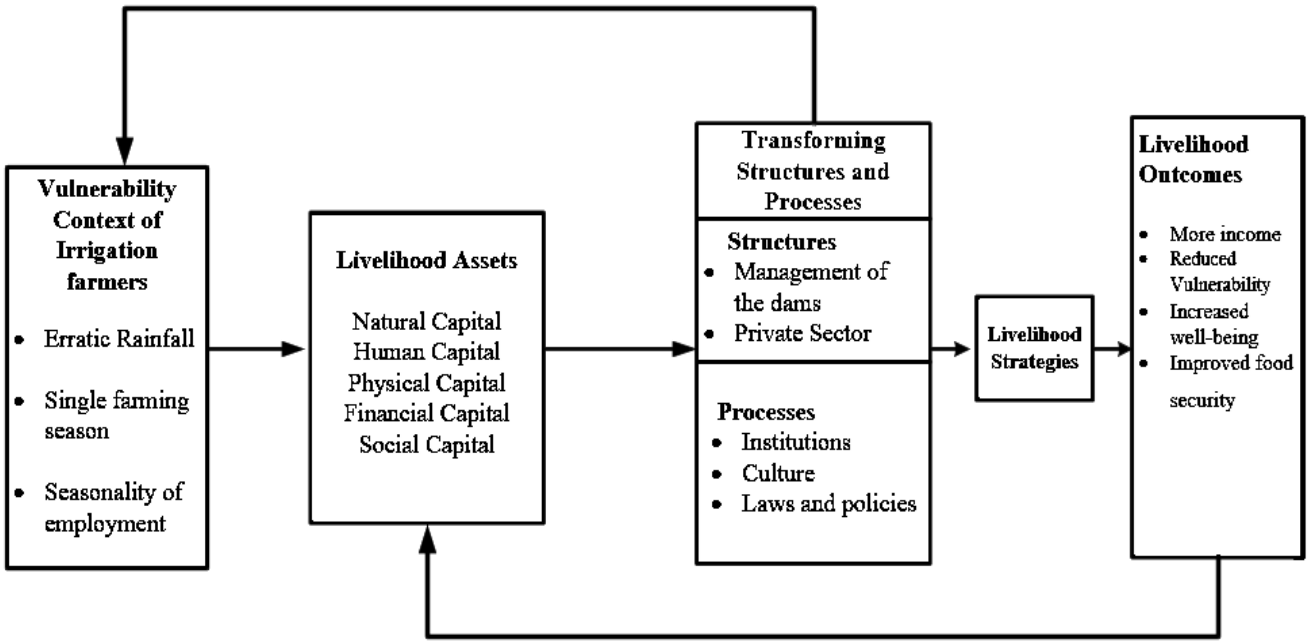

Figure. 2.1: DFID Sustainable livelihoods framework

Source: Adapted from Department for International Development, 2001

CHAPTER THREE

STUDY AREA AND METHODOLOGY

3.0 Introduction

This chapter has two parts with the first devoted to the profile of the study area. This details a map, the location and size, the vegetation and climate, the economy and agriculture, and the irrigation infrastructure of the study area. The second part, which is the methodology, defines the road map to investigating the effects of small-scale irrigation farming on rural livelihood in the Wa West District. The methods, rules and procedures that were required to collect the needed data that helped to answer the research questions of the study are outlined in this part. The philosophical basis of the study, the research design, the key research variables, procedures and techniques of sampling and data collection tools and methods are the important issues discussed.

3.1 Profile of Wa West District

3.1.1 Size and Location

Wa West district is located in the Upper West Region and was created in 2004 by the legislative instrument, LI 175. The District is bordered to the south by the Savannah region, the west by Burkina Faso, the east by Wa Municipal and the north-west by the Nadowli-Kaleo district. Approximately, it lies within longitudes 9°40'N and 10°10'N and also latitudes 2°20'W and 2°50'W. The District makes about 10% of Upper West region's total land size with approximately a land area of 18,478 square km. The District is the food basket of the Wa municipality based on its location and the sort of economic activities in the district. Commercial activities in the district are minimal, but there is a market for the agricultural produce in the district because of the Wa Municipality (WWDA, 2014).

3.1.2 Topography, Drainage and Geology

The district is drained by the black Volta which lies on the west of the district which serves as a boundary between Burkina Faso and the district. There are several hills which have heights between 180 and 300m above sea level. The topography is relatively flat. The soil is sandy loam along some of the tributaries of the Black Volta. The tributaries present opportunities for irrigation farming in the district to promote farming all year round. Unfortunately, the tributaries are seasonal and sometimes disrupt transportation, particularly in the rainy season along major roads in the district's capital. In the dry season, some of these tributaries also dry up, which makes dams construction very important in the district to store water for irrigation farming. The erratic nature of rainfall, together with traditional land-use practices and the nature of soils in the district harms the production of crops. This multifaceted situation makes the youth in the district look for various sources of livelihood and sustenance elsewhere without recourse to their health and lives (WWDA, 2014).

3.1.3 Vegetation and Climate

The district has a mean annual temperature ranging between 22.5°C and 45°C, and the climate is tropical continental. Trees found in the district are Baobab, Dawadawa, Kapok and Shea because of their drought and fire-resistant natures. The Guinea Savannah zone is where the Wa West district lies in the ecological zones of Ghana. The district vegetation is conducive for animal production which has a significant contribution to the incomes of households in the district. The main cash crops that are found in the district are cashew and mangoes. As a result of the prolonged dry season in the district, grasses dry up, and widespread bushfire sets in and this make the vegetation bare. The negative effects of the bushfires are felt when the rain sets in with soil erosions because of no plant cover (WWDA, 2014).

3.1.4 Culture

According to WWDA (2014), the district has three major ethnic groups. These are Dagaaba, Waale and Brifor. Notwithstanding the differences in names among the tribes in the district, the dialectical variation is quite insignificant. These tribes enjoy peaceful coexistence which has gains for economic and social development. There are other tribes like the Hausas, Asantes who are in the minority.

3.1.5 Literacy and Education

The district has a lot of illiterates who are within the ages of 20-65+. There are more illiterate females (57.7%) than illiterate males (42.3%) in the district (GSS, 2010; WWDA, 2014).

3.1.6 Economy and Agriculture

Fishing is done by a few members of the district who live along the banks of the Black Volta with most of the people in the district engaged in subsistence farming. The main economic activities of women in the district are extraction of Shea butter, brewing of pito and petty trading. Mixed farming is the main type of farming engaged by most of the farmers that is, animal and crop production. About 80% of the people in the district are engaged in agriculture. A combination of factors ranging from bad agronomic practices, inadequate technology, erratic rainfall pattern, low soil fertility account for the low productivity of crops in the district. One of the district's main cause of poverty is low crop production. The livestock production continues to make a steady improvement, notwithstanding the low gains made from crop production. Farmers are beginning to invest in livestock subsector (WWDA, 2014).

3.1.7 Irrigation Infrastructure

Due to the prolonged dry season, the District places a premium on irrigation facilities to help in dry season farming. The district has 16 dams and dugouts. Unfortunately, quite a few of them are used for irrigation and the total land area which is being irrigated in the district is 84 ha. Regardless of irrigation being a means of poverty reduction and its critical significance in the face of the climatic conditions of the district, the level of development of irrigation in the district is very low (WWDA, 2014).

3.1.8 Market Centres and Financial Services

According to the WWDA (2014), women in the district mostly market food crops and other household commodities. Men, on the other hand, trade in livestock. The poor road network and conditions in the district make physically accessing markets very difficult, particularly during the rainy season. Access to credit facilities in the district has been made very difficult because of the availability of a few banking services (WWDA, 2014). This has dire consequences for economic activities.

The WWDA in 2014 outlined development issues through the consultation of members of the various communities in the district as well as other stakeholder groups and the following development problems were identified;

- Lack of proper monitoring systems and the inadequacy of quality data
- Bad and ineffective cultural practices among smallholder farmers which results in poor yields
- Capacities of personnel in the district are weak coupled with inadequate to no logistics
- The district's capacity to generate employment is very weak

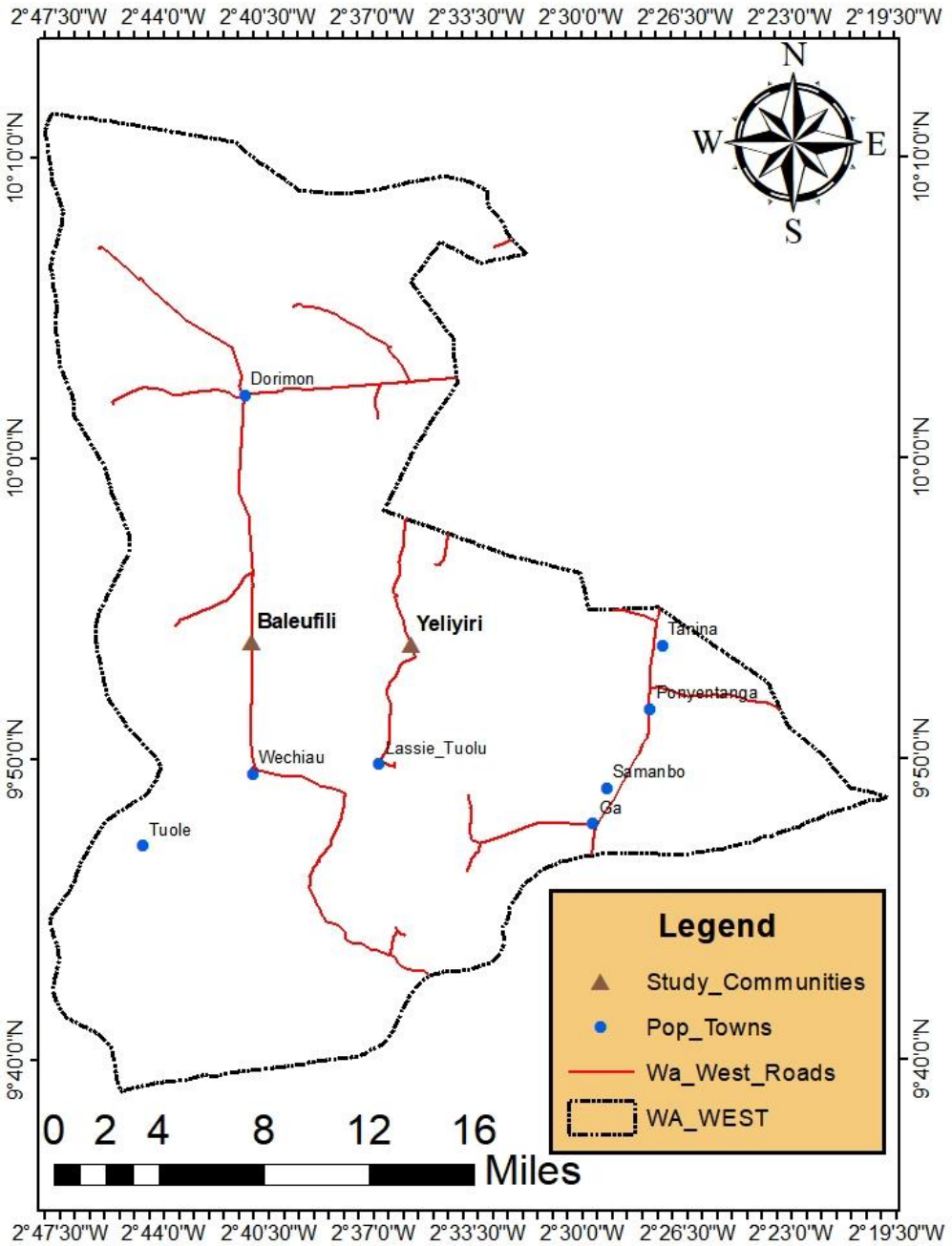

Figure 3.1: Map showing the study areas

Source: Author's Construct, 2020.

3.2 Methodology

3.2.1 Philosophical Underpinning of the Study

The philosophical basis of the research is the first idea that should come to mind when developing research. This is because there is a close relationship between the philosophy one would like to use and how one would go-ahead to use that particular philosophy (Creswell, 2014). This study adopts "pragmatism", and it came into existence because the truth about the real world could not be assessed solely by using one scientific method as the positivist and interpretivist advocated (Creswell, 2014; Kivunja & Kuyini, 2017). The pragmatic paradigm employs a combination of approaches that are more practical with different methods that would be able to throw more light on the actual behaviour of participants. It would also help to understand the beliefs behind those behaviours and consequences that could arise from different behaviours. It advocates research relationships that are deemed appropriate by the research relative to a particular study; thus, relational epistemology (Kivunja & Kuyini, 2017). A non-singular reality ontology which explains that individuals are unique hence have their interpretations of reality, and for that matter, there is no single reality. It also uses the mixed-method approach and conducts research that would be of benefit to people hence its value-laden axiology (Kivunja & Kuyini, 2017).

Pragmatism is not tied to one system of reality and philosophy (Creswell, 2014). This means that the research has the liberty to choose different techniques, common procedures and methods that are suitable for the purpose and needs of the study. The "what" and "how" of the research is what researchers who are philosophically inclined to pragmatism consider. They deal with approaches that are practical within the remits of the study (Creswell, 2014).

According to Rossman & Wilson (1985), what approach works best is what researchers focus on when undertaking their enquiry. This means researchers concentrate on the phenomenon and how the problem can be solved by answering relevant questions that have been asked. Multiple sources and methods of data collection are used to answer the research questions in a practical sense when the pragmatist philosophy is employed in a study. More often, both quantitative and qualitative methods are used to investigate a phenomenon within a real-life context (Kivunja & Kuyini, 2017). Some scholars are of the view that when a study uses qualitative and quantitative elements of data collection methods to analyse deeply and understand a research problem, then it is within the confines of the pragmatic paradigm (Creswell, 2014; Yin, 2009).

3.2.2 Research Approach and Design

A research approach is a plan, structure and strategy of an investigation so conceived as to obtain answers to research questions or problems (Creswell, 2009). It cuts across broader assumptions to detailed data collection methods, analysis and interpretation. Therefore, the study would adopt the mixed methods research approach and using the concurrent mixed methods research design. Creswell (2014), further asserts that a mixed methods research approach is used when both quantitative and qualitative data, together, provide a better understanding of your research problem than either type by itself. Also, it is used when one type of research (qualitative or quantitative) is not enough to address the research problem or questions. In mixed methods, a researcher can give equal priority to both quantitative and qualitative research, emphasize qualitative more, or emphasize quantitative more. This emphasis may result from practical constraints of data collection, the need to understand one form of data before proceeding to the next, or the audience preference for either quantitative or qualitative research (Creswell, Plano Clark, Gutmann, & Hanson, 2003). Under the mixed

methods, the research would be a case study. Cases are bounded by time and activity, and researchers collect detailed information using a variety of data collection procedures over a sustained period (Creswell, 2014). Case Studies are a design inquiry found in many fields, especially evaluation, in which the researchers develop an in-depth analysis of the case, often a programme, event, activity, process, one or more individuals. The study seeks to investigate the effects of small-scale irrigation on the livelihood of the farmers. The income-generation activities engaged in, farming type engaged in and livelihood activities that can be supported by incomes from farming were quantitatively analysed. In contrast, issues of management of the dams, challenges associated with irrigation farming and the relationship between migration and irrigation were analysed qualitatively. The mixed-methods approach emanates from the pragmatic worldview (Creswell, 2009).

Concurrent mixed methods procedures are those in which the researcher converges or merges quantitative and qualitative data to provide a comprehensive analysis of the research problem. In this design, the investigator collects both forms of data at the same time and then integrates the information in the interpretation of the overall results (Creswell, 2009). The concurrent triangulation design was used for this research. The triangulation design is one which gathers complementary data that are very distinct on the same topic, which can then be integrated for analysis and interpretation (Amalki, 2016). The purpose of a concurrent triangulation design is to use both qualitative and quantitative data more accurately to define relationships among variables of interest. It makes intuitive sense to gather information from different sources, using different methods, which work together as an efficient design (Creswell et al., 2003).

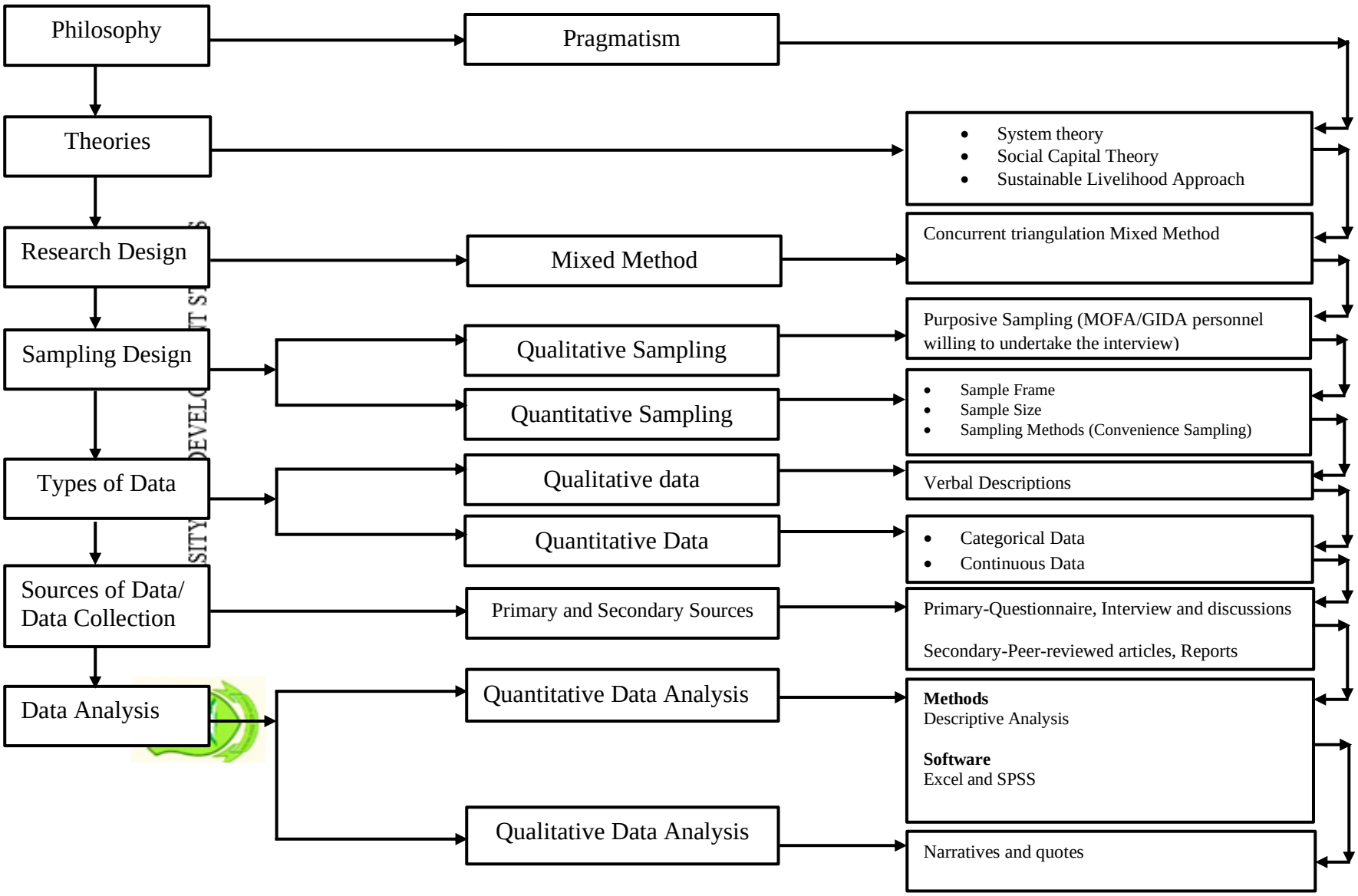

Figure 3.2: Methodological Framework

Source: Author's Construct, 2020.

3.2.3 Units of Analysis

This section of the chapter presents the key variables investigated as part of the study with their units of enquiry. Identifying and defining key variables and their units of enquiry helps to move the study from a conceptual level to an empirical level and thus shaping the focus of the research. The key variables include income-generation activities engaged in, farming type engaged in, livelihood activities that can be supported by incomes from farming, migration status and management of irrigation schemes. The irrigation farmers are the primary unit of analysis in this research. Other units of analysis are the Executives of the Irrigation Farmers' Association, GIDA and MoFA. These units provided the study with vital information regarding the activities of the irrigation farmers.

3.2.4 Sampling Procedure

In selecting the respondents for the study, mixed-methods sampling strategies were used. Purposive sampling is a nonrandom technique which does not need a set number of informants or theories (Lewis & Sheppard 2006). The research only decides on what needs to be known and looks for people who by their knowledge and experience can and are willing to provide the information. It is the deliberate selection of an informant because of the qualities the individual possesses. It is also known as "judgement sampling" (Bernard, 2002; Lewis & Sheppard 2006). This method of sampling was used to collect data from MoFA and GIDA. MoFA and GIDA are the two organisations that are to work hand-in-hand to see to the growth of Agriculture in general and irrigation respectively. Therefore, they are the institutions that have in-depth knowledge in the area of irrigation hence the need to purposively sample respondents from them for data collection. The convenience sampling method was used to select the required sample size from the total number of irrigation farmers. A convenience sample is a non-

probability sampling method where the sample is taken based on the availability of an easy-to-contact group of people (Babbie, 1990 as cited in Creswell 2009). The convenience sampling was used because most of the irrigation farmers were not available and as such those available were called to a meeting by the chief and the interviews were organised for irrigation farmers in the Baleufili community. In the Yeliyiri community, the same sampling method was used, but this was done with the help of the executive farmers calling for the meeting.

3.2.5 Sample Size Determination

There is no particular standard as to the number of participants required to generate meaningful outcomes in mixed-method research and how they should be chosen for participation (Teddlie & Tashakkori, 2009). The number and selection of respondents are decided by the nature of the mixture of qualitative and quantitative methods as well as by the depth of the information needed (Teddlie & Tashakkori, 2009). In mixed-methods research, what is practical in the study context determines the sample size and choice of the sample (Creswell, 2014). There are also diverse opinions on the suitable number of respondents required in research incorporating mixed-methods to draw meaningful conclusions and to generalize them carefully.

In determining the sample size, the total number of irrigation farmers was used as the sample frame. In Baleufili community, the total number of irrigation farmers were 105, comprising 91 males and 14 females. Yeliyiri, on the other hand, had 63 irrigation farmers comprising 54 males and 9 females. The sample frames for the study communities were taken from the secretaries of the various water user associations. The

sample size for the study was determined using a statistical formula provided by Yamane (1965). The formula is given by:

$n = \frac{N}{1+N\,(a)^2}$ Where; n = sample size, N = sample frame and α = margin of error.

Calculating the sample size for Baleufili using the formula

$$n = \frac{105}{1+105\,(0.05)^2} = 83$$

The sample size for Baleufili is 63 irrigation farmers

$$n = \frac{63}{1+63\,(0.05)^2} = 54$$

The sample size for Yeliyiri is 54 irrigation farmers

3.2.6 Sample Selection Techniques

Table 3.1: Sampling Techniques used for data collection from participants

Units of analysis	Sampling Technique	Definition
Irrigation Farmers	Convenience sampling	The researcher reached out to easily accessible irrigation farmers.
MoFA Representative	Purposive sampling	The researcher interviewed a person from MoFA based on the individual's position and knowledge of the issues under study.
GIDA Representative	Purposive sampling	The researcher interviewed two personnel from GIDA based on their knowledge of the issues under study.
Executives of the Irrigation farmers.	Purposive sampling	All Executive members who were available were part of the focus group discussion

Source: Author's Construct, 2019.

3.2.7 Data Collection

The study was done using both qualitative and quantitative approaches to data collection. The adoption of a multimethod approach is to enhance coverage and construct validity on the phenomenon being studied.

3.2.8 Data Sources and Types

Both primary and secondary sources of data were required for the success of this study. The primary sources of data provided the researcher with first-hand information from the field. Here, interviews and observation were the methods the researcher employed to collect relevant information from people who were relevant to the research. Secondary data is data that has already been collected and readily available from other sources. The main sources of secondary data included; articles, journals and publications, among others. The researcher collected data on farmers' livelihood, which were mainly quantitative and some qualitative data about the challenges farmers face and how they manage their dams for irrigation purposes. Qualitative data were also collected from two key organisations, and these are the Ghana Irrigation Development Authority and the Ministry of Food and Agriculture regarding the roles they play in the governance of the dams in the Wa West District. The data from all these sources were analysed, and recommendations were proffered through the findings that were made.

The primary sources included: the irrigation farmers gave data on how they use the dams for irrigation, the challenges they face and how they can make a living from them. Other primary sources were the Ghana Irrigation Development Authority and the Ministry of Food and Agriculture to find out their responsibilities and challenges associated with their duties insofar as these dams are concerned. Secondary data

obtained from literature were used to complement primary data gathered from the field. The literature was used to ascertain the relationship between what exists and what has been found, whether they are consistent or otherwise.

Table 3.2: Data Sources and Methods of Collection

Research Questions	Required Data	Data Sources	Data Collection Methods / Tools
1) What are the governing structures and how do they affect irrigation in the district?	• Dams management by irrigation farmers • Management structures put in place at the community level, district and regional levels • Roles played by MoFA and GIDA to ensure the effective use of the dam	Executives of Irrigation farmers' association GIDA, MOFA	Focus group discussion (Semi-structured interview guide) (See Appendix B) Semi-structured interview schedule (See Appendix C)
2) How does irrigation farming contribute to enhancing peoples' livelihood in the district?	• Livelihood support gained from irrigation farming • Challenges farmers face in irrigation farming?	Irrigation Farmers	Face to face interviews using structured Questionnaires (See Appendix A)
3) What is the relationship between irrigation farming and migration in the district?	• People who come from outside the district into the community as a result of the irrigation dams • People who migrate from the community to go elsewhere for alternative livelihoods • Prospects or challenges of people coming in or leaving the community	Irrigation Farmers Executives of irrigation farmers' associations	Face to face interviews using Structured Questionnaires (See Appendix A) Focus group discussion (Semi-structured interview guide) (See Appendix B)

Source: Author's construct, 2019.

3.3 Ethical Consideration

The research was done in conformity with the research ethics of the University. A cover letter was taken from the University as an assurance that the purpose of the study is

purely academic, and the anonymity of respondents is guaranteed. The research was done based on participants' volition. In situations where voice recordings were taken, participants were duly informed to seek their consent before going ahead to do it. This, according to Creswell (2014), assured them of confidentiality and anonymity. This gave the participants all the confidence they needed to reply favourably. The researcher acknowledged information that was used from other sources by using citations and references.

3.4 Data Processing, Analysis and Presentation

The most relevant aspect of research data analysis involves the reduction of data collected from the field to a meaningful and manageable size to come to a particular conclusion. The nature of data and methodological preferences of a researcher are some of the factors that determine how data is analysed (Dawson, 2002). The study would require an in-depth enquiry into the effects of irrigation farming in Wa West district on farmers' livelihood. Both qualitative and quantitative data gathered were examined, categorised, integrated and translated to ensure validity and provide logical evidence to get answers for the research questions. Data collected from irrigation farmers like income-generation activities, benefits of irrigation to livestock production and vice versa and the demographic characteristics of respondents (household size, marital status, ethnicity, religion) were edited and coded using Statistical Package for the Social Sciences (SPSS V26.0 for Windows). These data were analysed to produce frequencies, means and mode and percentages of the variables which were presented in tables and charts. Qualitative data were transcribed, and content analysis was done on qualitative data collected from the Executives of irrigation farmers associations in both communities, Ministry of Food and Agriculture and GIDA and the results were presented with some in the form of quotes.

CHAPTER FOUR

RESULTS AND DISCUSSION

4.0 Introduction

This chapter deals with the various variables that were understudied in this research in the Wa West district. The means, frequencies, percentages, minimum and maximum values, figures and tables and quotations from qualitative data of the various variables that were studied are presented in this chapter.

4.1 Demographic and Background Characteristics of Respondents

Table 4.1 highlights the demographic and background characteristics of respondents in the study areas. In Yeliyiri community, 54 respondents, comprising 8 females and 46 males were interviewed. In Baleufili community, out of the 83 respondents, 9 were females, and 74 were males. The reason for male dominance in irrigation farming is attributed to the fact that men are the heads of families and are supposed to provide for the needs of their households. With agriculture being the main economic activity of the district, it is expected that a lot of men would be engaged in it. The study established that 79.6% of male respondents in Yeliyiri and 89.2% in Baleufili were the breadwinners of their family.

Table 4.1: Demographic and Background characteristics of respondents

Variables	Y=54	Percentage	B=83	Percentage
Sex				
Male	46	85.2	74	89.2
Female	8	14.8	9	10.8
Age				
< or = 30	4	7.4	7	9.2
31- 39	20	37	26	34.2
> or = 40	30	55.6	43	56.6
Educational level				
No Formal Education	35	64.8	45	54.2
Primary	9	16.7	24	28.9
JHS/MSLC	6	11.1	12	14.5
SHS/O LEVEL/A LEVEL	3	5.6	0	0
Tertiary	1	1.9	2	2.4
Ethnicity				
Brifor	7	13.0	16	19.3
Dagaare	47	87.0	25	30.1
Waala	0	0	42	50.6
Religion				
Christian	13	24.1	27	32.5
Muslim	2	3.7	45	54.2
Traditional	39	72.2	11	13.3
Marital Status				
Single	5	9.3	4	4.8
Married	46	85.2	78	94.0
Widowed	3	5.6	1	1.2
Household size				
< or = 5	0	0	9	10.8
6-10	31	57.4	67	80.7
> or = 10	23	42.6	7	8.4
Occupation				
Teaching	1	1.9	1	1.2
Farming	53	98.1	77	92.8
Trading			3	3.6
Student			1	1.2
Welding			1	1.2
Bread winner				
Yes	43	79.6	74	89.2
No	11	20.4	9	10.8

Source: Field Survey, March 2020.

In table 4.1 above, the situation with the dominance of farmers was not different among the two study communities. Only one respondent, representing 1.2% in Yeliyiri works in the formal sector, the rest are farmers. This is similar to Baleufili, as 92.8% of the respondents were farmers.

Considering the ethnic composition of respondents, Dagaares are the majority (80%) in the Yeliyiri community. In Yeliyiri, 72.2% of respondents are Traditionalists. There were 50.6% of respondents being Waalas in the Baleufili community and 54.2% being Muslims. This lends credence to the fact that these communities are diverse in terms of their ethnicity and religion.

Also, there a lot of married respondents in the study communities representing 85.2% in Yeliyiri and 94% in Baleufili. The statistics indicate the majority of these farmers are married and have families to cater for. Contrary to Lawal (2017), he established that the marital status of irrigation farmers impacted high production among married farmers because they have bigger households than the single farmers, therefore, the need to provide more food. Although the majority of respondents were married, it did not have much impact on their productivity.

Concerning education in Yeliyiri, 64.8% of respondents had no formal education, and in Baleufili, 54.2% of respondents had no formal education. This corroborates a study by Anang, Bäckman, & Sipiläinen, (2019) that the level of education among smallholder farmers in Northern Ghana is low and therefore has the tendency of affecting farm production and adoption of technology.

There were 55.6% and 56.6% above 40 years with an average age of 40 years in Yeliyiri and Baleufili respectively. Respondents who were below the age of 30 were 7.4% and 9.2% in Yeliyiri and Baleufili respectively.

On the contrary, a study by Umar (2012) among irrigation farmers in Katsina State proved that farmers who were 55 years and above possessed enough experience that helped them in their farming to yield more. Unfortunately, this study could not establish that the advancement in age has been able to help these farmers increase their yield.

4.2 Governing Structures and their Effects on Irrigation

4.2.1 Management by Irrigation farmers

4.2.1.1 Irrigation lands allocation in the study communities

In Yeliyiri, the allocation of land for irrigation purposes is done by the chairperson of the Water Users' Association in consultation with other executive members of the Association. The irrigation land has been shared among community members. Currently, there is no uncultivated irrigatable land to be allocated to newcomers. For this reason, farmers are spoken to after the consultation about new members who want to use the facility. Some portions of their lands in most cases are volunteered to be given out to new farmers. In emphasising this, a respondent in the focus group discussion stated that:

> *... "there are no qualifications insofar as assessing a plot to farm on irrigation facility is concerned. It does not matter whether one is a male or female, young or old, married or not married, community member or an outsider. Once the individual can farm and expresses interest, land can be given to the person" (Excerpts from Focus Group Discussion, Yeliyiri, January 31, 2020).*

Unlike Yeliyiri, the chairman in consent with other executives exercise discretionary powers for land allocation. Baleufili has laid down procedures for the acquisition of land for irrigation purposes. The interested individual is taken to the chief so that being the overlord of the land; he would be aware of the person's intention and acceptance to farm in his community. If one is an outsider, a registration fee of One hundred Ghana cedis (GHS100) is to be paid after the person has agreed to abide by all the rules or regulations that have been spelt out to him or her by the executives about the dam. If the person is from the community too, he or she is expected to pay fifty Ghana cedis (GHS50) after the person has agreed to abide by all rules and regulations of the dam. After these processes have been executed, the individual is taken to the irrigation land by the executives with the consent of the chief and apportioned land for farming. For one to qualify to farm on the irrigation facility, one is supposed to be 18 years to be qualified. There are no criteria for choosing individuals who are qualified to use the irrigation facility. This means that once any person satisfies these obligations, he or she is qualified to get land for farming. This means that members of an entire household can register and get their lands to farm on the facility.

Farmers are the beneficiaries of the irrigation facilities, and there is a need for them to manage the facilities to benefit fully from them. In pursuit of this objective, irrigation farmers in the study areas put in measures to maintain the facilities properly. These communities have executive members who are in charge of running the management activities of the irrigation facilities. Some rules and regulations are adhered to by respondents to ensure the sustainability and proper functioning of the irrigation facilities. Coincidentally, the chiefs of the two communities are irrigation farmers, and

according to the respondents, this is an added advantage for adherence and prescription of punitive measures when the need arises.

In Yeliyiri, there is a 10-member executive committee which comprises 7 males and 3 females with a 5-year tenure. There is the chairman, Vice Chairman, Secretary, Organiser, Treasurer, Women Organiser and 4 other executive members. These executives are selected through an election, and one is nominated based on one's level of commitment towards the sustainability of the facility. They are responsible for decision-making affecting the irrigation and the welfare of irrigation farmers. The selection into an executive position is based on the commitment of a farmer to duty towards the dam. According to WUA and confirmed by GIDA, the election of executive members is facilitated by GIDA so that they can spell out the duties of the elected executives and how they can liaise with GIDA towards improving their irrigation activities and GIDA is enjoined by Legislative Instrument 2230 do this.

In Baleufili, a similar democratic process was used in choosing the executives of the Association. In this community, it has only a Chairman and a Secretary who are both males. Three committees comprise 17 members, and they are the Canal Committee comprising 1 female and 2 males, the Victims' Committee comprising 2 females and 7 males and the Dispute Settlement Committee which comprises 4 males and 1 female.

4.2.1.2 Maintenance of the Irrigation facilities

The irrigation facilities are supposed to be properly maintained so that they can serve the purposes for which they were constructed. Before the existence of the associations

in the study communities, both community members and irrigation farmers were farming close to the banks of the dams and leaving livestock to enter the dam. These challenging issues were difficult to be dealt with because no regulations were barring them. The various associations were formed and power vested in executives to enforce the regulations that were outlined. The FGD with the executives in Baleufili revealed that there were activities that included farming close to the banks of the dams, leaving livestock to enter the dam, washing directly into the water and fishing with chemicals. Consequently, there was a need to design rules and regulations to resolve them. To ensure the dam is in good shape, the rules and regulations designed in both communities include the following;

- One can only farm 300m close to the banks of the dam.
- No one is allowed to fish in the dam in Baleufili.
- No one is allowed to wash in the dam
- Cattle are not allowed to go freely into the dam. There is a designated area for them to drink
- No one should fish with toxic substances in the dams in Yeliyiri

Failure to comply with the rules and regulations above, some punitive measures are enforced. These include fines, restriction from using the facility and to a higher extent, being handed over to the police. Unfortunately, these bylaws and their sanctions are not properly documented. The respondents could not explain why they are not documented but stated they are known to everyone.

The research probed the financial aspect of maintenance, having dealt with the regulatory aspect of maintenance. The facilities need desilting when the water holding

capacities reduce, cracks in the canals are supposed to be patched when broken, leakages of valves and other maintenance issues. The study communities do not have maintenance schedules. They maintain as and when the need arises and whether or not the problem is within their financial capacity. In Baleufili, the money raised from registration is kept for these purposes. Still, it is woefully inadequate and not available for major maintenance because they may have been used for other minor maintenance purposes. Another source of revenue for maintenance is the sale of fish. The fisheries department comes yearly to catch the fish in the dam; hence the regulation no one should fish. The harvest is divided into three. One goes to the department, one to the community and the last part to the Water Users' Association. The money accrued from the sale is also saved for maintenance purposes. In the situation where the money is not sufficient, irrigation farmers contribute to getting the issue resolved if they can.

Yeliyiri community does not have any sources of revenue for maintenance purposes save for the farmers' contribution. Initially, when the facility was not challenged, farmers contributed towards maintenance after every sale of their produce. Currently, they have stopped contributing and do when the need arises because they hardly make profit from their irrigation farming. The Associations rely on the Ghana Irrigation Development Authority (GIDA) for solutions to any challenges that are associated with the facility. The District Assembly is sometimes asked for assistance, but it is always difficult to get a response even though they are deemed the last resort when all efforts to get their problems resolved proves futile. A respondent reiterated GIDA's support for maintenance and sustainability by saying that;

> … *"the dam used to collect an inadequate amount of water. With the least rain, it is full, but the water is used a few times, and it cannot*

> *supply our farmlands. GIDA came and desilted the dam, and now it can hold sufficient water." (Excerpts from Focus Group Discussion, Baleufili, February 3, 2020).*

The FGD with the executives in Baleufili revealed that the spillway was not properly constructed. Hence, when excess water is channelled out of the facility, the spillway would rather carry sand together with the water that was supposed to leave back into the dam. This was filling the dam with silt. A complaint was made to GIDA, and they came to correct the situation. Notwithstanding GIDA's intermittent support to respondents, the respondents bemoaned getting solutions from other stakeholders is a challenge. In cases where the needed assistance by respondents could not be met, they keep on waiting for help to come, which has dire consequences for the sustainability of the facilities particularly if it takes a longer time.

Similarly, a study by Mosha, Kajembe, Tarimo, Vedeld, & Mbeyale (2016), permits are granted to irrigators who are willing to pay water fees after they have harvested their produce. Irrigators in the Kilombero schemes are permitted to do irrigation all year round. There are sanctions, conditions necessary for membership, bylaws and a cost recovery system which stays as the guiding principles for water allocation and distribution. These bylaws, however, differ from district to district. Aside from these bylaws, some norms prohibit farmers and community members from washing or bathing in the irrigation canals. The study supports Mosha et al., (2016) as it established the existence of an informal structure which enforces rules that have been created by itself. Conflicts are resolved by respected elders within the clans and villages. The significance of the informal structure cannot be downplayed insofar as regulating the behaviours of irrigators for efficient and effective resource usage.

Another study in Bontanga and Golinga by Braimah, King, & Sulemana, (2014), revealed that there were maintenance, finance, marketing and women's committees with various functions and all these committees work together to promote the irrigator's shared responsibilities regarding operations and maintenance. Water User Groups are in charge of small-scale irrigations in the northern part of Ghana. The study corroborates research by Kurian and Dietz (2005) and Fujile, Hayami & Kikuchi (2005) in their studies in Harayana-India and Philippines respectively. They found that operational rules have positive impacts on the management of water and conservation of resources in both the short and long terms in irrigation schemes that have diverse local water users.

4.2.2 Management by Ghana Irrigation Development Authority

4.2.2.1 Role of GIDA in the Management of Irrigation

GIDA is an authority under the Ministry of Food and Agriculture. The responsibility of GIDA in achieving the objective of the construction of dams is to provide the technical know-how in the construction of dams and building the capacity of farmers to use these facilities. GIDA builds the irrigation dams, and it has the technical expertise for the construction of dams, management of the dams and for the operationalisation of the facilities. The authority is therefore mandated by law to harness water resources for agricultural purposes in Ghana. GIDA's role in irrigation is supervisory. It builds the capacity, supervises and sets the rules for the operationalisation and the usability of irrigation schemes. GIDA in the Upper West region is supposed to play these roles to benefit all the 127 irrigation sites in the region.

4.2.2.2 Objective for the establishment of the irrigation schemes

The objective for the construction of dams is to harness water resources for the development of agriculture productivity and to ensure food security to improve the livelihood of farmers and rural communities. Notwithstanding the primary purpose of the construction of dams, they provide a source of water for livestock, for domestic purposes such as washing, recreational purposes such as swimming and fish farming.

4.3 Potentials and Challenges of the Irrigation facilities under study according to GIDA

There are potentials available for the farmers to undertake their irrigation activities. In a key informant interview, the respondent outlined the potentials of the irrigation facilities and how they can be harnessed for optimum utilization and high production. The valley for the irrigation site in Baleufili is very large. The soil is fertile, and it can support vegetable production in the dry season and rice farming in the rainy season. It can support intensive crop production for three times in a year. Irrigation is supposed to allow the farmers to cultivate from day one to the last day of the year. There is enough water in the reservoir. The capacity and resources are available for them to use. There is an avenue for aquaculture development. Both schemes have similar potentials.

The respondent mentioned challenges these schemes face from the GIDA point of view. For farmers to be able to get the best out of the facilities, they are supposed to work hand in hand with the authority. The respondent said;

> *… "farmers are not organised and properly trained. We are supposed to organize and train them so that they can function properly as an institution, but that is not the case. There are pest and disease infestation as a result of the insufficient training given to farmers. Farmers cultivate one particular crop which is tomatoes continuously because it is profitable, but this is a bad agronomic practice. Because we are not able to train them, they find it difficult to adhere to our advice" (Key informant interview, January 30, 2020).*

The authority is supposed to conscientize, sensitise and educate the farmers on good agronomic practices, to harness the potential of the dam for optimum utilisation and high production, the

4.4 Management Structure of GIDA

Figure 4.1 indicates the management structure of GIDA in the Upper West region.

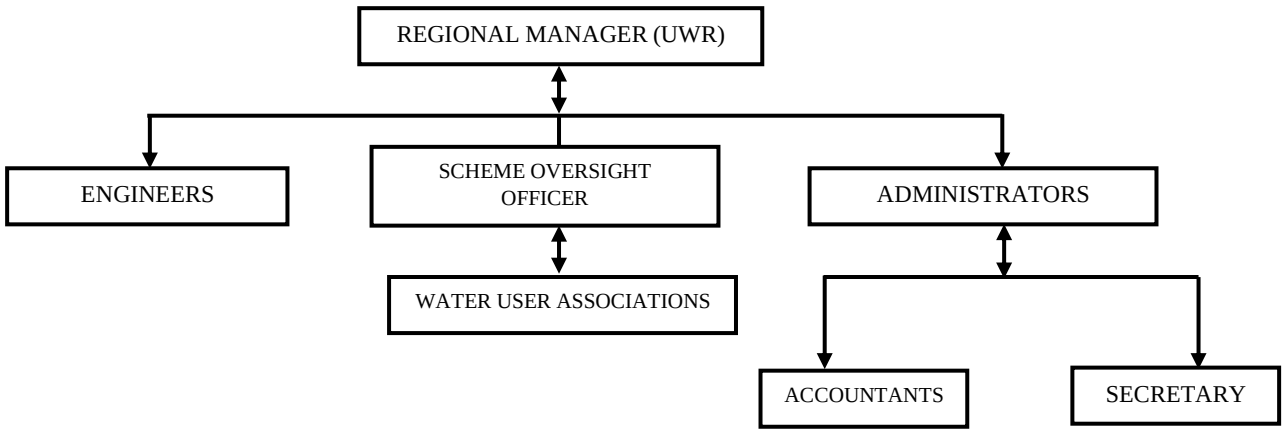

Figure 4.1: Governance Structure of GIDA (Upper West Region)

Source: Field Survey, 2020.

GIDA has its management structure that helps in the discharge of its mandate. This structure emanates from the national level but has been drawn to represent the structure in the Upper West region situation currently. The current governance structure, to some extent, helps in advancing the utilisation of irrigation schemes by the personnel, but resources are woefully inadequate for it to execute its mandate effectively.

4.5 Relationship of GIDA with other institutions in managing the irrigation schemes

Table 4.2 shows GIDA has a mutual relationship with the two main organizations. This relationship has gone to support irrigation farmers and GIDA immensely in their activities.

Table 4.2: GIDA's relationship with other organisations

NAME OF INSTITUTION	NATURE OF RELATIONSHIP	BENEFITS OF RELATIONSHIP	CHALLENGES OF RELATIONSHIP
GIZ	Mutual relationship by providing the resources and GIDA undertaking the training of the farmers	Provided resources like seeds, fuel and fertilizer for GIDA to use in training the farmers to achieve its mandate	No challenges
International Fertilizer Development Center	Mutual relationship by providing the resources and GIDA undertaking the training of the farmers	Provided resources like seeds, fuel and fertilizer for GIDA to use in training the farmers to achieve its mandate	No challenges

Source: Field Survey, January 2020

GIDA works with other institutions to be able to manage the irrigation schemes in the Upper West region. The authority is constrained in many ways and therefore relies on the benevolence of other institutions like GIZ and International Fertiliser Development Centre to get some funding for training of irrigation farmers and some farm inputs for demonstration farms which are key in the education of farmers. The authority does not have any challenges insofar as a relationship with these institutions are concerned.

4.6 Management by the Ministry of Food and Agriculture (MOFA)

Management Structure of MOFA

The structure of MOFA in the district starts with the District Director of Agriculture, District Agric Officers (DAOs) and Technical Officers (Agric Extension Field Officers). There are supposed to be six DAOs with one being in charge of the management of information, one in charge of crops, another of extension, then women and agriculture development and last but not least plant protection. There are five area councils in Wa West; these are Dorimon, Vieri, Wechiau, Ga and Gurungu. The DAOs are assigned to the various area councils in the Wa West District and each DAO in a particular zone is referred to as a zonal supervisor.

4.7 Relationship Between MOFA And Other Organisations

Some organisations often partner with MOFA to support farmers in the district. These organisations are mostly non-profit organisations. MOFA has a working relationship with World Vision, GIZ, Masara N'arziki, among others. These organisations help all farmers in general, not specifically irrigation farmers. In 2018, GIZ trained over 2500 farmers which included irrigation farmers on disease and pest management and safe handling of agrochemicals. The respondent emphasized the benefit of that partnership and how future partnership could benefit farmers by adding that;

> *…"the intervention brought to the attention of farmers the hazardous nature of these chemicals hence the need to protect themselves when applying or getting into contact with them. The training was beneficial because the fall armyworm infestation had struck Ghana. Farmers were advised to conduct constant monitoring on the farms and report any unusual situation to take action before the situation escalates" (Key informant interview, February 22, 2020).*

4.8 Irrigation and Government's Planting for Food and Jobs (PFJ)

Government has subsidized some certified seeds and fertilizers under the PFJ for farmers. Since farmers do not get access to extension officers, many of them do not have information as to where they can get these products. Government has made provision for organic fertilisers which is less harmful to plants and human lives, and these are subsidized too. Under the PFJ, there is provision for irrigation farmers, and this is often captured in the annual action plans of the Department of Agriculture for two training programs to be organised in a year for them. This is done through the identification of farmers who are doing very well in their activities. Considering the inadequate coordination between farmers and the department, respondents do not get the necessary information that would help them take part in some of these beneficial activities. This has contributed to some extent the poor yields farmers have been making over the years. The findings are consistent with other studies that, in pursuit of the promotion of agricultural growth through agricultural water management and irrigation, the Ghana Irrigation Development Authority as a public sector organisation was established (Glitse, Nyamadi, Darkwah, & Mintah, 2017). It is GIDA's mandate to see to water management, undertaking civil engineering, supervision of irrigation facilities, and provision of aquaculture services to both individuals and the public.

Aside from the activities of GIDA prescribed by law, which is managing and regulating public irrigation schemes, it is also supposed to promote the establishment and regulation of Water Users Association all over the country (GIDA, 2016a). Also, there is an existing cordial and good working relationship between GIDA and Development Partners that make financial and technical provisions towards the construction of small-scale irrigation facilities (Glitse, Nyamadi, Mintah, & Feruta-Benee, 2018). Major

stakeholders such as farmers, government (MMDAs, GIDA, MoFA), policymakers, research institutions and non-governmental organizations must make contributions on efforts to restore irrigation structures, enhance input availability, make credit accessible and improve extension services to speed up the development of already existing schemes in the region (Segtub, Geophrey, Anornu, & Ofosu, 2018).

4.9 Irrigation Farming and Livelihood

4.9.1 Main Sources of Income for Farmers

The main source of income of the respondents is irrigation farming, with others engaged in activities like pito brewing, craftsmanship, livestock rearing, among other activities to support their livelihoods. This is represented in table 4.3.

Table 4.3: Main and other sources of income of respondents

	Y=54	Percentage	B=83	Percentage
Main sources of income				
Farming	52	96.2	83	98.8
Teaching	1	1.9	0	0
Craftmanship	1	1.9	1	1.2
Other activities to earn income				
Galamsey	2	3.7	0	0
Pito Brewing	6	10.9	3	3.7
Poultry	1	1.9	0	0
Rearing Cattle for sale	4	7.5	0	0
Rearing Goats and Fowls for sale	2	3.7	6	7.2
Retailing of Petrol	2	3.7	0	0
Selling Beans Cakes (koose)	1	1.9	1	1.2
Farming	2	3.7	1	1.2
Vulcanizing	1	1.9	0	0
Welding	0	0	1	1.2
No other activities to earn income	33	61.1	71	85.5

Source: Field Survey, March 2020.

Irrigation farming is the main source of income for 96.2% and 98.8% of respondents in Yeliyiri and Baleufili, respectively. In Yeliyiri and Baleufili, 38.9% and 14.5% of respondents undertake other income-generating activities in addition to farming as their main sources of income. Other income sources for respondents were pito brewing and selling of beans cakes mainly among women, teaching, craftsmanship, and selling of provisions. There were 61.1% and 85.5% in Yeliyiri and Baleufili, respectively who do not engage in any other economic activity to earn income. These findings are similar to Rao (2006), whose study found that smallholder farmers had strategies to deal with their vulnerability and poverty which included; agro-processing like pito brewing, dry season farming, livestock production, mining among others. Table 4.3 highlights the main and other income sources of respondents.

4.9.2 Seasons of Farming Respondents Engaged in

All respondents in the Yeliyiri community do both rainy and dry season farming. In Yeliyiri, all respondents took rainy season farming as their primary farming and dry season farming as their secondary farming. In Baleufili, 97.6% of respondents practice the rainy season farming as their primary farming, and 2.4% chose dry season farming as their primary farming. This is as a result of the fact that farmers can farm on vast pieces of land during the rainy season but during the dry season the irrigation site is not apportioned to farmers in larger sizes. This means that farmers in both communities do their traditional farming which is often in the rainy season and still support themselves with dry season farming. They tend to supplement their rainy season farming with what they make from the dry season farming (irrigation farming).

Type of Farming Respondents Engage in and how often they engage in them.

In Yeliyiri, no respondent goes into irrigation farming to mainly feed their family, 1.9% of respondents do it for commercial purposes, and 98.1% of the respondents do it for both commercial and sustenance. In Baleufili, 1 respondent undertakes irrigation farming for sustenance, no respondent does it for commercial purpose, and 98.8% of respondents do it for both commercial and sustenance. Most of the farmers undertake irrigation for both commercial and sustenance because they need to feed their families. Since farming is their main economic activity, they engage in it to feed and also sell some of their produce to support the livelihood of their families. For this reason, respondents in Yeliyiri, all do irrigation farming annually, and respondents in Baleufili, have two respondents engaging in irrigation farming biennially with the remaining 81 respondents farming annually. These statistics show that farming is an important part of the economic life of the respondents in this research. A study in Wa West District and Tolon by Boafo, Saito, & Takeuchi (2014), established that about 80% of households that took part in the study primarily depended on ecosystem services like irrigation for feeding their family which is supported by the statistics above which is to feed the family basically and selling to get money to take care of educational and health needs (commercial).

4.9.3 Livelihoods support of respondents through Irrigation Farming

The study established that respondents were able to support their livelihoods in various ways. Tables 4.4 indicates some of the livelihood objectives respondents could get with the help of irrigation farming in Yeliyiri and Baleufili communities.

Table 4.4: Irrigation farming and its contribution to livelihood objectives of in Yeliyiri and Baleufili Communities.

Livelihood objectives	Does irrigation farming contribute to the following livelihood objectives?			
	Yeliyiri		**Baleufili**	
	YES (%)	**NO (%)**	**YES (%)**	**NO (%)**
Support education of anyone in your household	92.6	7.4	95.2	4.8
Provide health insurance or healthcare for your household	96.3	3.7	97.6	2.4
Provide shelter if needed for your household	46.3	53.7	37.3	62.7
Bought some assets (motorbike, land, bicycle, light-duty farm implements, grinding mill, etc.)	59.3	40.7	41	59
Employed farm labour	64.8	35.2	33.7	66.3
Hire capital intensive services for farming (e.g. Tractor)	85.2	14.8	34.9	65.1
Bought some farm inputs (e.g. Fertilizer, seeds etc.)	96.3	3.7	96.4	3.6
Bought Livestock (cattle, goats, sheep, guinea fowls, donkeys, etc.)	92.6	7.4	47	53

Source: Field Survey, March 2020.

One objective of the research is to ascertain whether or not irrigation farmers can support their livelihoods through their activities. Respondents in Yeliyiri and Baleufili attested to the fact that they were able to support their livelihood through irrigation farming. Three main livelihood outcomes were under consideration, but other areas of irrigation farming supports were also considered. The researcher sought to find out whether the irrigation farmers were able to support the education of anyone in their households, provide health insurance or health care for their households and provision of shelter for their households. In Yeliyiri, 92.6% of respondents were able to support

the education of members of their household through irrigation farming. With the provision of health insurance or health care, 96.3% of respondents were able to do this for their households. Also, 46.3% of respondents could provide shelter through their engagement in irrigation farming.

In Baleufili, 95.2% of respondents were able to support the education of people in their households through their engagement in irrigation farming. With health insurance and healthcare provision for their household, 97.6% of respondents were able to make that available for their households through their engagement in irrigation farming. With the provision of shelter, 37.3% of respondents could provide for shelter for their household. Some of the respondents were able to employ farm labour, buy some assets like motorbikes, land, bicycles, hire capital-intensive services for farming (e.g. tractor), buy some farm inputs (e.g. fertiliser, seeds), buying of livestock and all these go to support their livelihood through their engagement in irrigation farming. This corroborates studies by the Food and Agriculture Organisation (2014) that, irrigation farming is proven to have a significant role in increasing income. Also, a study by Bhandari & Pandey (2006) in Nepal among 324 households found that irrigation farmers had increased income which positively affected their livelihoods.

4.9.4 Factors Farmers Consider in Choosing the Crops They Want to Cultivate

Respondents had divergent reasons for selecting crops for cultivation. Good production and easiest to cultivate were the main reasons for respondents in Yeliyiri and Baleufili, respectively. Good production would help them get enough produce to feed their families and get some for sale. Easiest to cultivate, on the other hand, would reduce the

cost of inputs, time and labour since most respondents indicated inadequate financial support as a challenge. This is represented in Figure 4.2.

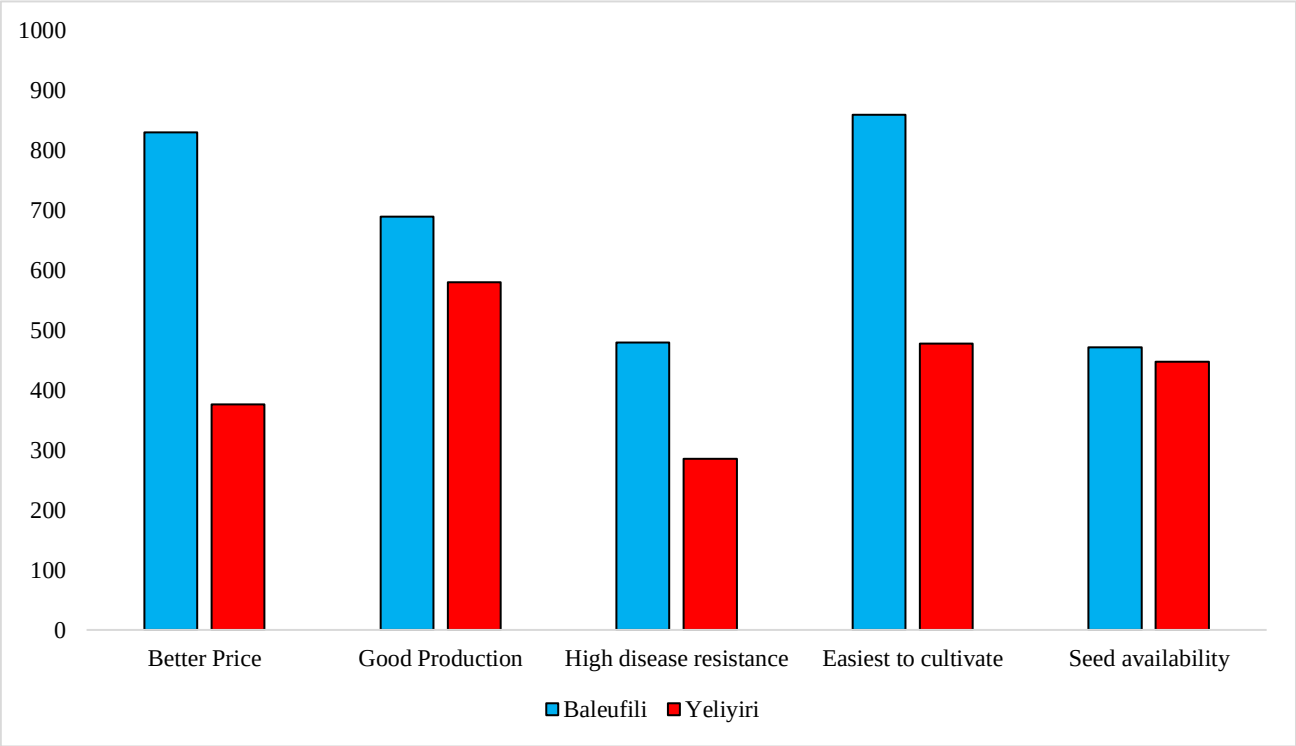

Figure 4.2: Factors Farmers Consider in Choosing the Crops They Want to Cultivate

Source: Field Survey, March 2020.

Irrigation farmers have challenges that militate against their economic activities. For these reasons, farmers are always prudent in choosing the type of crop they want to cultivate in other to minimise their losses. Crops that are mainly cultivated are tomatoes, pepper, green pepper, cucumber, cabbage and pumpkin. Multiple responses were collected from respondents. The responses were ranked from 1 to 5. That is, the highest reason to the least reason. One weighted 12 points, 2 weighted 10 points, 3 weighted 8 points, 4 weighted 6 points and 5 weighted 4 points. The researcher computed the results and came up with Figure 4.4 below. In Yeliyiri, good production (yield) was the first reason for the selection of a type of crop by the respondents, followed by easiest

to cultivate which, seed availability, better price and high disease resistance respectively. In Baleufili, easiest to cultivate, better price, good production (yield), high disease resistance and seed availability in that order. This was consistent with a study by Agula et al. (2019), that farmers in northern focus a lot on yield.

4.9.5 Benefits of irrigation to farmers

In Figure 4.3, the benefits of irrigation farming to farmers are established.

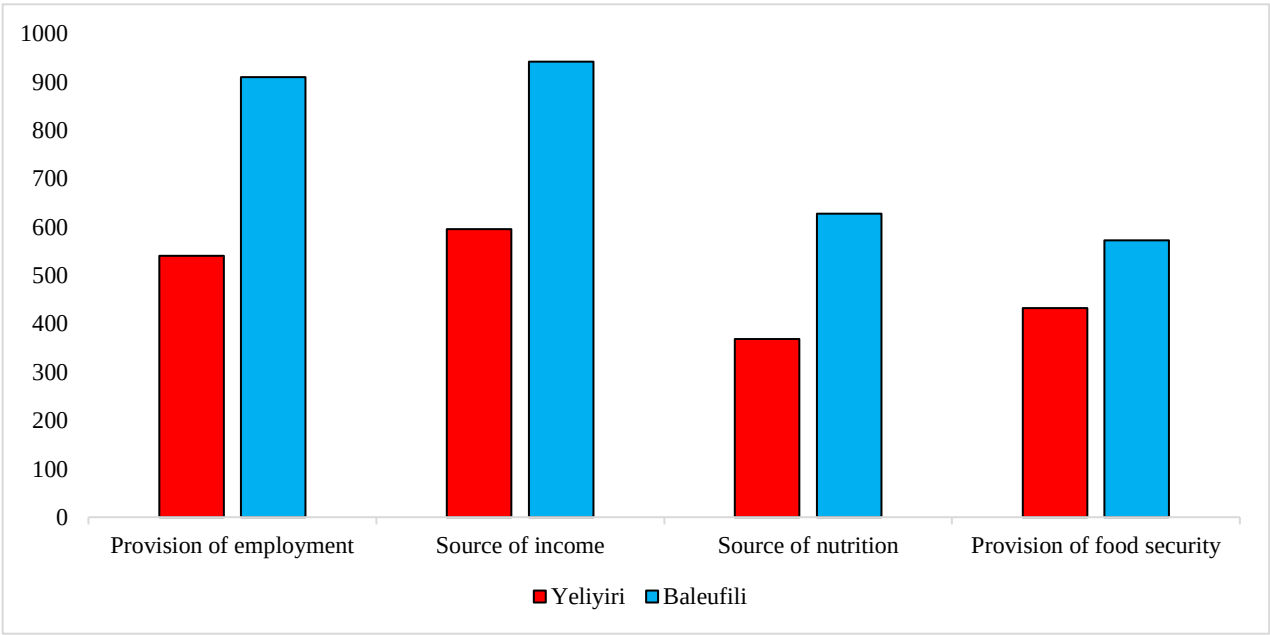

Figure 4.3: Irrigation Farming and its benefits to Respondents

Source: Field Survey, March 2020.

In Yeliyiri, source of income was the first benefit of irrigation farming to farmers, provision of employment, provision of food security and source of nutrition respectively. In Baleufili, source of income was the first benefit of irrigation to farmers, provision of employment, source of nutrition and provision of food security respectively. Figure 4.3 shows that the respondents are into irrigation farming to get income to support their livelihoods before any other reason. Similarly, a study by Chazovachii (2012), revealed the majority of the respondents' engagement in the

irrigation project enabled them to take their wards to school, take care of the medical expenses and improve the nutritional needs of their families.

4.9.6 Irrigation farming support for livestock Production and Vice Versa.

Figure 4.4 below shows that majority of respondents in Baleufili supported livestock production using income from irrigation farming to access veterinary services for their livestock and few of them bought more livestock from irrigation farming income in both study communities. In Yeliyiri, drinking water source was the main benefit most farmers got for their livestock through irrigation farming.

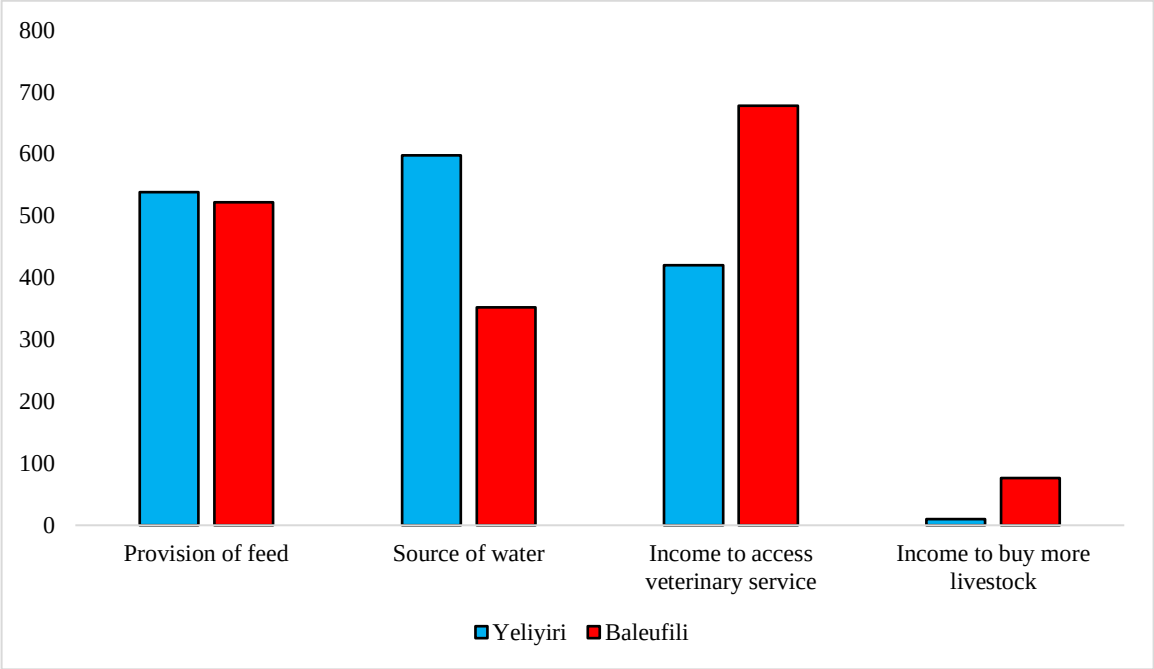

Figure 4.4: Irrigation Farming support for livestock production

Source: Field Survey, March 2020.

In Yeliyiri, 96.3% of the respondents asserted that irrigation farming helps in livestock production, and the same number of respondents said livestock production helps in irrigation farming. In Baleufili, 90.4% of the respondents supported the same. Respondents in Yeliyiri, irrigation farming supports livestock production using the dam as a source of water for livestock was the highest benefit, provision of feed to livestock

from some produce from the irrigation farming, income from irrigation helps farmers to access veterinary services for their livestock and income from irrigation gave respondents money to buy more livestock respectively. In Baleufili, source of water, provision of feed, income to access veterinary service, and income to buy more livestock was the order in which irrigation helps in livestock production in Figure 4.4 above.

Livestock production benefits respondents in both communities. Livestock being sold to help in irrigation farming was the benefit most farmers in both Yeliyiri (96.3%) and Baleufili (84.3%) derive. Respondents in Baleufili (3.6%) sold livestock to hire labour and farm implements for their farming activities with no respondent from Yeliyiri. This is consistent with a study by Acheampong, Balana, Nimoh, & Abaidoo (2018), which indicated about 70% of respondents tend to benefit in multiple folds from the opportunities presented by irrigation through farming, drinking water source for livestock and domestic use. Also, there was green pasture around the dam which provided feed for livestock, and they also made livestock income from the sale of their animals.

4.10 Challenges of Irrigation Farming

There are challenges the main actors (farmers, MoFA and GIDA) in irrigation farming in the Wa West District face. These challenges are outlined below.

According to the farmers, there is no ready market for their produce. The vegetables are always on the farms, and when buyers come, respondents go to harvest the produce for the buyers. Tomatoes and pepper are the only vegetables that people buy in small quantities in the surrounding communities. Other vegetables like cucumber, green

pepper, okra and garden eggs, buyers often come from Wa to buy the produce. The non-availability of the ready market causes farmers to often sell their produce at very cheap prices for fear of they getting rotten on the farms. This, according to the farmers, makes the work very difficult and unprofitable.

Limited storage facilities: Another issue that the farmers consider very challenging is the fact that they have no storage facilities and no known methods of storing their vegetables for longer durations. This situation causes most of them to lose their produce on the farms. As a strategy to minimise losses, the farmers sell their produce at lower prices to bulk buyers (middlemen). Farmers are better of selling them at lower prices than leaving them on the farms to get rotten. Market women even take advantage of the situation and buy the produce on credit. They sell them and still come to pay pittances for the produce.

Limited access to credit: There is inadequate financial support to be able to engage in farming. The farmers stated that vegetable production is capital intensive. Also, they do not make profits from their farming activities, coupled with no other high income-generating occupations to support them. These make it difficult for them to get enough money to engage in farming activity.

Inadequate infrastructure and poor maintenance: The mechanization of the dams is challenged, making irrigation difficult. The canal does not channel water to every part of the irrigatable area. This is because the canal was not constructed to the farthest part of the land and also where the canal passes through, some parts have been blocked. The

land is not flat, and the canal was constructed in such a way that it is very difficult for the water when opened to spread evenly on the land. This leads to one side of the land having sufficient water and the other side not having. This has forced most farmers' in Yeliyiri whose parcels of land do not have sufficient water to leave their lands since they cannot afford pumping machines. The farmers suggested that the renovation of the current canal and the construction of a new canal would help immensely to sufficiently supply water to the whole irrigable area. Farmers in Baleufili emphasized the poor mechanization of the dam and how it has affected their land sizes for cultivation. The irrigable area is on higher land, and the canal is on a lowland. This results in the water that is being channelled through the canal not being able to reach the entire land. There is a deep gutter beside the canal which was made for the overflow of water. Unfortunately, when water is opened to supply the farms, it runs into the gutter and makes the land marshy. This makes that part of the land not suitable for cultivating vegetable, which is the main crop produced by farms.

Disease and pest infestation: Disease infestation was also another issue that the farmers are fraught with. According to GIDA, the lands are infected with nematodes, and as a result, farmers are supposed to farm different vegetables in rotation and also get resistant varieties to the disease. According to the respondents, they moved from farming tomatoes to cucumber, cabbage and other vegetables, but their vegetables were still infected. According to them, they could farm, and the vegetables would mature after they have invested their time, labour, fertilizer and seeds. At the maturity stage, the vegetables then start to wilt. A respondent said;

> *"Last year, I cultivated pepper, and it matured. At the maturity stage, all the plants wilted. It is sometimes so intense that one cannot get a basin of*

tomatoes from an acre of land. This challenging situation has caused most of us to stop farming" (Focus Group Discussion, Yeliyiri, January 31, 2020).

This has dire consequences on their major source of livelihood. The disease infestation, in particular, has worsened their plight because the inadequate proceeds accrued from farming is invested into it and it turns out to be efforts in futility.

Farmers acknowledged that as a result of their illiteracy, their farming activities are negatively impacted. From table 4.1 above, most of the respondents are illiterates. They farm vegetables which are not the traditional crops known among farmers in the Upper West region. For this reason, good and different agronomic practices are supposed to learn. The farmers cannot read these on their own, and with little to no help of agriculture experts, this has caused a lot of difficulties in their activities. A respondent bemoaned;

…."a majority of us are illiterates so when we have a problem with our farms, we could be asked to go and purchase a particular chemical or use something which we do not even know where or how to get it. With the disease that affects our cucumber, we were told to plant a particular flower which has bitter roots, and that can solve the problem. As we sit here, none of us even knows the name of the plant" (Focus Group Discussion, Baleufili, February 3, 2020).

Farmers also complained about the fact that there is so much silt in the water and for that matter around January, February, March, the water level reduces drastically. According to them, the dam has not been desilted for a very long time. This has caused the dam to hold an insufficient amount of water. This makes the dam run out of water during the dry season when there is heat which causes evaporation and high usage of water for farming purposes.

Limited access to extension services: Farmers also decried the fact that extension services are not enough for them. They acknowledged the fact that demonstration farms are always very beneficial to them since they can see and follow what is being done. As of 2018, the number of extension officers in the Wa West district was three. The number of farmers in the district is about 90,000 with around 230 farming communities. It would be very difficult if not impossible for the three officers to cover the entire district to provide extension services considering these dynamics. This has made extension services unavailable to a lot of farmers in the district. Only a few farmers who could call the extension officers benefit from them. In 2019, the government recruited many extension services officers, and Wa west district had 10 of them, and this brings the number of extension service officers to 13. Wa West district has 18 operational areas, and each Agric extension officer is supposed to handle 1500 farmers. Even in the face of the increment, which is an improvement, there is a need for more extension officers.

There is no fence in the Baleufili irrigation facility. This has been very challenging for farmers because they find it difficult to control livestock and other animals from entering their farms to destroy crops. Farmers have requested support to get a fence from the District Assembly and GIDA, but nothing has come out of their requests. There has never been a fence on the facility, and they have always been asking for it to be provided.

Different studies in Northern Ghana corroborate these challenges identified by farmers in the study areas. Namara et al. (2011) looked into the growth of irrigation in Ghana, past experiences, potential prospects and future directions. They found that the

problems facing irrigation in Ghana were financial incapacity, administrative issues, access to inputs and services, marketing and post-harvest handling. Similar findings were made by Abdulai (2018) revealed that local economic development, improvement in farm productivity and agriculture modernisation had been hampered in Ghana because of access to credit by smallholder irrigation farmers and high cost of inputs. Appiah-Nkansah (2009) looked at Upper West region's irrigation systems. He pointed out that irrigation in Ghana is fraught with problems ranging from poorly managed canals, weeds and mud covering networks of canals, lack of storage facilities, the absence of ready markets and lack of access to extension services. In a related study, the Government was blamed for poor maintenance structures (Owusu, Nyantakyi, and Borkloe, 2013) and poor mechanisation of irrigation facilities to allow levelled irrigable lands for optimum water use (Kyei-Baffour & Ofori, 2007).

GIDA is the organization that is mandated by law to oversee the activities of irrigation farming in Ghana. Considering the importance of the work of this organization, it has challenges that make its work difficult. Below are some of the challenges faced by GIDA in the Upper West region.

Funding from the central government to the authority is insufficient. There are a lot of activities that are supposed to be undertaken by GIDA, but as a result of insufficient funds or sometimes the unavailability of funds, these activities are not undertaken. The government provides the infrastructure for irrigation because the construction is capital-intensive. A key informant stated that most rural areas in Ghana could not have afforded them if not for donor and government support. The irrigation schemes are supposed to be functional to maintain themselves, and for this reason, a system was put in place

which is referred to as the "Water User Associations" which is backed by law. These associations are supposed to be supervised by the authority to build their capacities to self-manage themselves to achieve the goals and objectives espoused by the authority. The inadequacy of funds from central government has made the provision of capacity building exercises for farmers difficult in the region. The authority as it stands now does not have enough resources to undertake any such activities that would ultimately benefit the farmers. The respondent said;

> *…"that can explain why perhaps, farmers are unable to use this potential to be able to achieve the objectives they are supposed to achieve. I am supposed to go around all the 127 irrigation facilities in the region and build the capacity of farmers. I have no car which will take me around for this purpose." (Key informant interview, January 30, 2020).*

Inadequate level of coordination between farmers and the authority. GIDA's resource constraint makes it difficult to undertake its responsibilities. It becomes very difficult for the authority to visit all the irrigation schemes in the region within a year to support farmers with capacity building. This means that farmers do not get the requisite training and assistance that can help them in farming activities. The level of coordination and cooperation between the farmers and GIDA is supposed to be one that is intensive, but as a result of some of the challenges, the authority is not able to reach them. That notwithstanding, the respondent said

> *…"farmers are aware they are supposed to contact GIDA and those who know, do come. If they come, we can train them, and if they call seeking advice, we are also able to provide that for them. Unfortunately, they do not come or call as we expect. So, I will say the level of coordination is about 50%". (Key informant interview, January 30, 2020).*

There is an inadequate level of coordination between GIDA and MoFA, although they all work under the same Ministry. To a larger extent, there is supposed to be some

coordination between GIDA and the Agric department. Unfortunately, the authority and the department often operate in isolation. GIDA often goes to the District and starts working in the communities without involving the Agric department in the district. The lack of coordination also leads to missing out on some expertise and information from the agriculture department. A typical example was cited about a situation in Baleufili by the respondent that;

> *……"fishponds are being constructed in the community and not until I visited there, I didn't know there was any such activity being undertaken. There was a conflict because some people had their okra farms where the ponds were to be constructed, and they had to be destroyed. Probably if they consulted the Agriculture Department, it could have liaised with the people to iron out this issue because we have been working with them over the years" (Key informant interview, February 22, 2020).*

The Agric department is resource-constrained to the extent that the department has no office in the district. Its office is in the regional capital, Wa. This makes proper supervision and coordination between farmers and the department difficult. Officers from the Department are supposed to have means of transportation like motorbikes that can cope with the terrain of the district. These are not available and thus make movement very difficult.

4.11 Relationship Between Migration and Irrigation Farming

The study also sought to find out the push and pull factors of migration insofar as irrigation farming is concerned. The research wanted to find out whether or not the irrigation facility brought people from elsewhere to come into the communities also to get themselves employed, get income among other benefits of irrigation farming to support themselves and their families. The study also sought to find out whether or not there are some problems or challenges with the irrigation facilities which have rather

caused farmers to move from their communities elsewhere to seek greener pastures to support their and families' livelihood. In Yeliyiri, 68.5% of respondents have moved out of the community purposely stay somewhere within the last one year, and 38.6% of respondents in Baleufili have also moved out of the community similarly. Numerous reasons were given for moving out of the community to other places for better economic conditions. Two main reasons given by respondents in the two communities were for farming and menial jobs. This lends credence to the fact that there are some underlining issues with the irrigation facilities in these communities. Less than 5% of respondents move out of the community for formal employment, for further education and to learn a trade.

A respondent in Baleufili, had this to say about the migration challenge in the community;

> *"The disease and pest infestation cause most of the youth to migrate during the dry season. All these houses roofed with zinc were from proceeds of the irrigation farming when it was vibrant. When the community members themselves are leaving the facility, what would attract an outsider to come here and do irrigation farming?" (Focus Group Discussion, Male Executive Respondent, Baleufili, February 3, 2020).*

Another executive in the same community affirmed the need to migrate to provide for the needs of her family. The women also join the men to move. She said;

> *..."we the women too, we join them (men). We go to Kumasi and other cities in the south to work as head porters. We go to do this so that we can also get money to take care of our needs and that of our family" (Excerpts from Focus Group Discussion, Baleufili, February 3, 2020).*

Table 4.5 establishes why people migrate, how often they migrate, the challenges and benefits of their migration to irrigation farming and how migration benefits the livelihood of their households.

Table 4.5: Migration among households of irrigation farmers.

Why did you move out					
	Yeliyiri (No of Respondents	%	Baleufili (No of Respondents	**%**	
For formal employment	0	0	0	0	
For further education	0	0	1	1.2	
For farming	12	22.2	20	24.1	
For menial jobs	35	64.8	16	19.3	
Apprenticeship	0	0	1	1.2	
Did Your Migration Affect the Livelihood of Your Household?					
Yes	35	64.8	22	26.5	
No	1	1.9	8	9.6	
How did Your Migration Affect the Livelihood of Your Household?					
Remittances	31	57.4	16	19.3	
Provision of accommodation	0	0	0	0	
Provision of employment	8	14.8	2	2.4	
Reduced Labour	10	18.5	12	14.5	
Did Any of The Benefits of Your Migration Help in Irrigation Farming?					
Yes	36	66.7	23	27.7	
No	0	0	5	6	
Has Anyone in Your Family Moved Out of The Community Purposely to Stay Somewhere in The Last One Year?					
Yes	45	83.3	57	68.7	
No	9	16.7	26	31.3	
Why did the person move out?					
For formal employment	1	1.9	7	8.4	
For further education	29	53.7	14	16.9	
For farming	28	51.9	4	4.8	
For menial jobs	30	55.6	31	37.3	
Did the person's Migration Affect the Livelihood of Your Household?					
Yes	33	61.1	25	30.1	
No	11	20.4	25	30.1	
How did the person's Migration Affect the Livelihood of Your Household?					
Remittances	31	57.4	24	28.9	
Provision of accommodation	1	1.9	3	3.6	
Provision of employment	22	40.7	7	8.4	
Reduced Labour	12	22.2	11	13.3	
Did any Of the Benefits Of the person's migration Help in Irrigation Farming?					
Yes	33	61.1	19	22.9	
No	11	20.4	14	16.9	
How often do you move out?					

Annually	23	42.6	8	9.6	
Biennially	10	18.5	3	3.6	
Rarely	17	31.5	15	18.2	
Do you make more money when you move out?					
Yes	45	83.3	23	27.7	
No	5	9.3	8	9.6	
Do you think it is more helpful in moving to other locations?					
Yes	48	88.9	37	44.6	
No	6	11.1	46	55.4	

Source: Field Survey, March 2020.

With the movement of respondents out of their communities, 42.6% of respondents in Yeliyiri moved annually, 31.5% moved rarely, and 18.5% moved biennially. In Baleufili, 13.3% of respondents moved annually, 4.8% moved biennially, and 19.3% moved rarely.

The researcher went further to probe whether or not migration affected the livelihood of the household of the respondents. In Yeliyiri, 61.1% of respondents confirmed migration affected the livelihoods of their households. In Baleufili, 30.1% of respondents confirmed migration affected the livelihoods of their households. In respect of how the migration affected the livelihood of their household, 57.4% respondents in Yeliyiri said they sent remittances to relatives to support their livelihood back in the community when they were away, 40.7% respondents said it helped employ them, 1.9% was able to provide accommodation, and 22.2% said it reduced the labour of their households. In Baleufili, 19.3% of the respondents said they sent remittances to their families, no respondent was able to provide accommodation for their families, 2.4% were able to provide employment, and 14.5% said it reduced the labour of their households. In furtherance of the objective of whether or not migration has a

relationship with irrigation farming, the study sought to find out whether the benefits of migration of the respondents helped in irrigation farming. In Yeliyiri, 61.1% of the respondents confirmed migration benefits helped in irrigation farming, and 20.4% of respondents said otherwise. In Baleufili, 27.7% of respondents confirmed migration helped in irrigation farming, and 6% said it did not. The respondents stated that remittances were used to buy seeds and fertilizer for irrigation farming.

Respondents had members of their households migrating to other parts of the country. In Yeliyiri, 83.3% of respondents had members of their household migrating while 16.7% had no members of their households migrating. Baleufili, had 68.7% of respondents who had members of their household migrating while 31.3% did not have members migrating. Members of the households of the respondents had different reasons for migrating with migrating for menial jobs being the highest in both communities. Table 4.5 shows the reasons for migration by members of the household of respondents. In respect of the person's migration affecting the livelihood of the household of the respondents, their migration affected the livelihood of the respondents' household through receiving of remittances, provision of accommodation, provision of employment and reduced labour.

Farmers migrate for farming and menial jobs and can support the livelihood of their households to engage in irrigation farming by mainly remitting them. A major challenge that was revealed by the study about migration is that it reduced labour among households. The youth go out of the communities to seek greener pastures, especially in rural and peri-urban areas in the middle and southern part of Ghana. These are people

who have the energy to be able to farm intensively. However, the challenging situation of irrigation which renders them unemployed in the dry season forces them to migrate. Irrigation farming benefits from migration among respondents because remittances are used for buying farm inputs. Majority of respondents who migrate indicated they do that annually, and they think it is more helpful moving out of their communities to search for alternative sources of livelihood. The study established that respondents make more money when they move out than when they engage in irrigation farming currently.

In table 4.5 above, 88.9% and 44.6% of respondents in Yeliyiri and Baleufili respectively, acknowledged migration being beneficial. In Yeliyiri, 83.3% of respondents and 27.7% in Baleufili affirmed they make more money when they move out of their communities. This is consistent with a study by Dinye (2013) which indicated that farming has led to the decline in the movement of the youth out to urban areas in the southern parts of Ghana in search of greener pastures. Notwithstanding this, the income accrued from irrigation farming as a result of its associated problems is not enough to decrease the out-flow of the youth significantly. Also, studies have revealed that simple relationship does exist between agriculture and migration partly because remittances received by relatives are sometimes invested in agriculture. That is, when the consumption and other spending needs of households have been completely met, the household will invest remittances in agriculture as well as increase productivity in the event of an extended migration duration (Cohen, 2005). A study by Jokisch's (2002) in two Ecuadorian communities to assess the land-use and agricultural production of migrant and non-migrant households found contrary results. It was observed that migration had neither contributed to a decline in agricultural production nor committed

remittances to improvements in agriculture. The result was that migrant households are not substantially different from non-migrant households in the use of land and agricultural production.

CHAPTER FIVE

MAJOR FINDINGS, CONCLUSION AND RECOMMENDATIONS

5.0 Introduction

The study set out on unravel the effects of small-scale irrigation on the livelihoods of farmers. There were three objectives that the study sought to achieve; to identify the governing structures and how they affect irrigation, assess the contribution of irrigation farming to farmers livelihood and examine the relationship between migration and irrigation farming in Wa West district. This chapter presents the major findings, conclusions from the study. It proffers recommendations to ensure that small-scale irrigation farmers can have sustained livelihoods from effective and efficient utilization of irrigation facilities.

5.1 Major Findings

The major findings from the study have been classified under the various objectives of the study, which include; irrigation and management, irrigation and livelihood and irrigation and migration.

Irrigation and management

Management by irrigation farmers

The study established that in Yeliyiri, the land was allocated through the discretion of some executive members, but in Baleufili, one must satisfy some conditions which include; being ready to abide by their rules and regulations governing their facility and paying ¢100 as an outsider and ¢50 as a community member. Elections are used to select executives of the various Water User Groups. Various committees have been formed in Baleufili, but Yeliyiri has none. The chiefs of the two communities are also irrigation farmers, and this strengthens the adherence to laid down rules and regulations.

The executives are responsible for decision-making affecting the irrigation facilities and the welfare of their members. The study established that, when irrigation farming was thriving in the two communities, contributions were often made during harvesting towards the maintenance of the irrigation. Unfortunately, this practice has halted because respondents barely make anything substantial from their irrigation farming now.

In Baleufili, the one-time payment made by new irrigation farmers is used for maintenance and also the sale of their share from fish harvested by the fisheries department from the dam. If there is the urgent need for maintenance, farmers make contributions towards that, but in the situation where they cannot deal with it financially, they seek support from GIDA or the WWDA and wait until they are assisted. This has its repercussions on the sustainability of the dam because of the prolonged duration to getting it maintained. Also, the various Water User Groups are not well organised to make them creditworthy. For example, they do not operate any active bank account, they do not write minutes, and they do not take the attendance of members during meetings. Considering these challenges, they have associations, but technically they are not in the eyes of credit facilities like banks to give them loans for their activities.

Management by other stakeholders

The study revealed that GIDA is not well resourced to undertake its duties in the region. It does not have enough financial resources to cover all irrigation facilities in the region. This hampers regular visits to irrigation sites. GIDA has a good working relationship with other partners like GIZ and IFDC, which inures to the benefit of irrigation farming

in the region. Also, there is inadequate coordination between GIDA and MOFA. There is also an inadequate level of coordination between farmers and GIDA. It was established that farmers grasp what they are being taught well through demonstration farms, but because there is inadequate funding from the government, they are not able to benefit from such.

MOFA does not have enough extension service personnel to provide services to farmers in the district. The department is resource-constrained, and this has led to its office located in the regional capital instead of the district. Furthermore, farmers use a lot of chemical fertilisers for their farming activities which are harmful to their health and that of the environment. Farmers do not get relevant information; therefore, most of them do not know that for example, certified seeds and fertilisers have been subsidised for them under the Planting for Food and Jobs Programme. All these can be attributed to the lack of extension services.

Irrigation and livelihood

Irrigation farming in the study communities is male-dominated. Majority of farmers are married and with a relatively large household size with an average of 6 members in a household. Farmers were mostly over the age of 40, and this means that people who are a bit advanced in age engage in irrigation farming. There is ethnic and religious diversity, yet these farmers work with minimal conflicts. The study revealed that most farmers were not educated and this proved to have aggravated their plights in their farming activities. It was revealed that farming is the main source of income for the respondents, and rainy season farming is considered as the primary farming for most farmers with dry season farming being the secondary. Also, most farmers go into

irrigation farming for both sustenance and commercial purposes. They can feed their families through farming activities and sell some of their produce to take care of the needs of their households; hence, the majority farm annually. The study revealed that most farmers were able to provide for the education, health and accommodation needs of their households through the proceeds of their irrigation farming. Others were able to buy assets and livestock for rearing from the proceeds of irrigation farming.

Also, irrigation farming serves as a source of employment, source of income, provision of security and source of nutrition for farmers and their households. The study further revealed that irrigation farming and livestock rearing provided support for each other. Irrigation provided water sources for livestock, provided green pasture for livestock, income realised from irrigation was used to provide veterinary services for livestock. Conversely, livestock is sold to hire labour and buy farm inputs for irrigation farming. Challenges that were revealed to militate against irrigation farming hence the livelihood of respondents are;

- No ready market for their produce
- No storage facilities
- Inadequate financial support
- Poor mechanisation of irrigation dams
- Disease and pest infestation
- Dams filled with silt leading to a reduction in water levels in dry seasons
- Lack of extension services

- The high illiteracy rate among farmers
- No fence to protect from livestock and other animals

However, the study revealed that the challenges faced by the two communities have more drastic consequences on irrigation in Yeliyiri than Baleufili. This accounted for the few respondents because most people had abandoned irrigation farming in the community. Some farmers in Baleufili adopted a strategy of digging wells on their farms because the canal could not evenly distribute water to their farms. They draw water from the wells to irrigate their farms which is good but unfortunately reduces the size of their farmlands.

Irrigation and migration

The study set out to also reveal the push and pull factors of migration towards the irrigation facilities in the study areas. It was revealed that as a result of the challenges the irrigation schemes face, the youth in the communities migrate to other places to seek greener pastures. This could be the reason for the average age of irrigation farmers being 40 years. The main reasons given by respondents for the migration of members of their households was to engage in farming and menial jobs for income elsewhere. In Yeliyiri, 42.6% of respondents migrated, compared to 13.3% in Baleufili. More respondents acknowledged the effects of migration on their livelihood in Yeliyiri than Baleufili. These effects ranged from sending remittances to their families back home, provision of employment for their families and reduction in labour for farming activities. Some respondents acknowledged migration was beneficial to irrigation farming with 61.1% in Yeliyiri and 27.7% in Baleufili. The study indicated that respondents make more money from menial jobs they undertake when they migrate than they make from their current irrigation farming. In Yeliyiri, 83.3% of respondents

affirmed making more money when they migrate and 27.7% in Baleufili. It was established that the current state of the irrigation facilities tends to push people away from the study communities to seek alternative livelihoods in the dry season, and it barely brings anyone into them.

5.2 Conclusion

With irrigation and livelihood, most irrigation farmers earn little from their irrigation activities. This has resulted in a situation where few people are actively engaged in irrigation farming. Although the income realised from irrigation supports their livelihoods, it does not raise their standard of living. Their main source of income is farming with few of them engaged in other economic activities. The study further concludes that farmers have parcels of land that are allocated to them. Still, because of the challenges, the irrigation facilities are fraught with, they do not get to farm on the entire land that has been allocated them. It was established from this study that irrigation helps in livestock rearing and vice versa.

The study established that farmers are facing challenges ranging from no ready markets, inadequate extension services, no fence, poor dam mechanisation, no storage facilities and no credit facilities. The study also set out to investigate the relationship between migration and irrigation. The result brings to the conclusion that a lot of people migrate elsewhere to look for alternative livelihood opportunities even with the availability of the irrigation facilities. Because the facilities are challenged, the farmers acknowledged that they make more money when they migrate than when they engage in irrigation farming. Farmers also acknowledged the benefits of their migration to irrigation farming and the livelihood of their households. The irrigation facilities have not been

able to serve as a stimulus to draw other people to come into the communities to do irrigation farming. The farmers affirmed being better of doing irrigation farming than migrating to do menial jobs elsewhere if not for the challenges they are faced with.

Furthermore, the study set out to identify the governing structures of the irrigation activities and how they affect irrigation farming. The study concludes from the results that, there are governing structures at both the informal level (Water User Groups) and formal level (GIDA). These governing structures endeavour to play their roles towards the effective and efficient utilisation of the dams to ensure agricultural productivity. Unfortunately, the study revealed there were lapses in the way informal level operates. They are not organised very well to be able to position themselves to take up challenges and responsibilities relating to raising funds. About rules and regulations, they can enforce them, and this has positive effects on the sustainability of the facilities. The study further concludes that GIDA is not effective and efficient with its oversight responsibilities because of financial resource constraint. This goes to affect the activities of these farmers and their livelihoods in the long run. The Ministry of Food and Agriculture also has not been effective and efficient due to similar challenges faced by GIDA. This notwithstanding, there is no proper coordination between the two government organisations, although they operate under the same Ministry. This has consequences on reports on the agricultural outlook of the district.

5.3 Recommendations

Based on the findings, the following recommendations have been made for a consideration by the various stakeholders;

Considering the low level of education among irrigation farmers, the Ministry of Food and Agriculture together with the Ghana Irrigation Development Authority should partner with other stakeholders to organise regular training and workshops to broaden the knowledge base of farmers on the need to adhere to good agronomic practices. These training and workshops can be used to introduce new technologies and innovative ways of undertaking farming to increase productivity.

Also, dry season farming should be promoted by making the various Water User Groups formidable. The supervisory organisations should outline measures that can make these Water User Groups creditworthy so that they can be eligible for loans. The current state of the groups would not allow financial institutions to support them with credit. Furthermore, formidable groups can determine prices and can be linked to buyers which can help in solving the problems of low pricing and no ready markets.

Irrigation farmers should be given relevant information that can help them in their activities. There is, therefore, the need for the provision of adequate extension services by MOFA. This would be able to assist farmers right a lot of wrongs that are done at the early stages, which would reduce their losses. Also, there should be proper communication channels and coordination among all stakeholders. This can help proffer better solutions and dedication of resources to mitigate the challenges associated with irrigation farming.

The irrigation facilities should be desilted when the need arises for the retention of enough water, properly mechanizing them and provision of support like fencing them.

GIDA and MOFA should test soil and water samples and any other research that can be done to ascertain the sources of the diseases and pest infestation to remedy the situation. This has been the most challenging issue irrigation farmers face from the study.

Finally, the government should see to the timely and sufficient allocation of funds to all stakeholders that engage in irrigation related activities. This will allow them to get the requisite logistics and human resource to be able to undertake their responsibilities dutifully. Furthermore, the government should evaluate the performance of irrigation facilities countrywide. This should be independent of those that are done by organisations in charge of irrigation to assess their potentials and challenges and how to harness and mitigate them, respectively.

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APPENDICES

Appendix A: Structured Interview Schedule for Irrigation Farmers

UNIVERSITY FOR DEVELOPMENT STUDIES
FACULTY OF PLANNING AND LAND MANAGEMENT
DEPARTMENT OF GOVERNANCE AND DEVELOPMENT MANAGEMENT
STRUCTURED INTERVIEW SCHEDULE FOR IRRIGATION FARMERS

The researcher is a postgraduate student of the University for Development Studies pursuing an MPhil in Development Management. This study seeks information on the topic- **SMALL-SCALE IRRIGATION FARMING AND ITS EFFECTS ON RURAL LIVELIHOOD IN THE WA WEST DISTRICT OF GHANA.** Information given will solely be used for this research. You are also assured of full confidentiality, privacy and anonymity of any information that you provide.
Participating in this interview will attract no rewards and your participation in the study is solely voluntary. You are also free to discontinue your participation at any stage of the study. You are however commended for agreeing to participate in the study. You are kindly requested to answer the questions as frankly and openly as you can. Thank you.

Name of Community.....

Questionnaire No……. Date.....

SECTION ONE: DEMOGRAPHIC CHARACTERISTICS OF RESPONDENTS		
1.	(DO NOT ASK THIS QUESTION- simply provide the answer) Sex of respondent	1. Female [ ] 2. Male [ ]
2.	How old are you?	…… years
3.	What is your main occupation?	1. Teaching [ ] 2. Trading [ ] 3. Farming [ ] 4. Casual labour [ ] 5. Other, specify……..
4.	What is your ethnic background?	……..……
5.	What is your Marital Status?	1. Single [ ] 2. Married [ ] 3. Divorced [ ] 4. Separated [ ] 5. Widow [ ]
6.	What is your household size?	…… .
7.	How many rooms do you occupy with your household?	
8.	What is your religion?	1.Christian [ ] 2. Muslim [ ] 3. Traditional [ ] 4.Others(Specify)……..

9.	What is or are your source(s) of income	……..
10	What is your average monthly earning from your main source of income?	……..
11	Are you the main bread winner of the family?	1. Yes [ ] 2. No [ ]
12	What is your level of education?	1. No Formal Education [ ] 2. Primary [ ] 3. JHS/MSLC [ ] 4. SHS/O level/A level [ ] 5.Tertiary [ ] 6. Technical/Vocational
	SECTION TWO: IRRIGATION FARMING AND LIVELIHOOD	
13	Do you farm both in the rainy season and dry season?	1. Yes [ ] 2. No [ ]
14	Which farming do you consider primary?	1. Dry season farming [ ] 2. Rainy season farming [ ]
15	Which farming do you consider secondary?	1. Dry season farming [ ] 2. Rainy season farming [ ]
16	Which of these farming activities are you involved in?	(Tick all those applicable) 1. Sustenance [ ] 2. Commercial [ ] 3. Both [ ]
17	Why do you engage in irrigation farming?	Rank with 1=Highest, 2=Higher, 3=High, 4=low, To generate cash/income [ ] To produce food for the household [ ] To Produce livestock feed [ ] Others (specify)…….
18	How long have you been engaged in irrigation farming?	
19	How often do you engage in irrigation farming?	1. Annually [ ] 2. Biennially [ ] 3. Others, specify……..
20	Estimate how much you invest in irrigation farming	
21	Do you engage in other activities that give you income?	1. Yes [ ] 2. No [ ]
22	If yes to 21, what are the activities you do to earn income?	……
23	Which of the activities in 21 earn you more income?	…….

Livelihood opportunities and how irrigation agriculture can affect livelihood opportunities. Tick those applicable to respondent

24	In the last 12 months have you been able to do any of the following?	1-YES/2-NO Y/N	Were you because of your engagement in irrigation farming? 1-YES/2-NO	Is there any change in your livelihood outcomes because of irrigation? If Yes, in which way?
i.	Support Education of anyone in your household			
ii.	Provide health insurance or healthcare for your household			
iii.	Provide shelter if needed for your household			
iv.	Bought some assets (motorbike, land, bicycle, light duty farm implements, grinding mill, etc)			
v.	Employed farm labour			
vi.	Hire Capital intensive services for farming (eg. Tractor)			
vii	Bought some farm inputs (eg. Fertilizer, seeds etc.)			
vii	Bought Livestock (cattle, goats, sheep, guinea fowls, donkeys, etc.)			

Crop production in irrigation and rain-fed agriculture, provide response based on what is applicable to you.

25	**Types of Crops** **D.S = Dry season** **R.S = Rainy**	**Plot size (acres)** D.S & R.S		**Total production** (Indicate Unit of measurement) D.S & R.S		**Q'ty Consumed at home** D.S & R.S		**Q'ty sold** D.S & R.S		**Unit price** D.S & R.S		**Amount realised** D.S & R.S	
i.	Cereals (Maize, millet, sorghum, etc.)												

ii.	Legumes (beans, groundnuts, etc.)												
iii.	Tubers and vines (yam, cassava, sweet potato, etc.)												
iv.	Vegetables (pepper, tomato, green pepper, lettuce etc.)												
v.	Plantain, bananas												
vi.	Fruits (mango, cashew, oranges, etc.)												
vii	Others, specify												

26	Why do you select the above type of crops for your irrigation farming?	Rank responses with 1st, 2nd, 3rd, 4th, etc 1. Better price [ ] 2. Good production [ ] 3. High disease tolerance [ ] 4. Easiest to cultivate [ ] 5. Seed availability [ ] 6. Others (Specify)…….
27	What do you think about the prices given to your produce at the market?	1. Good [ ] 2. Fair [ ] 3. Bad [ ]
28	How would you describe the yields of the crops?	1. Good [ ] 2. Bad [ ] 3. Average [ ]
29	What was your estimated monthly income from rain-fed farming?	
30	What was your estimated monthly income from irrigation farming 2 years ago?	
31	What is your estimated monthly income from irrigation farming now?	
32	Comparing irrigation farming some years back and irrigation farming now, what would you say about your production?	1. Good [ ] 2. Bad [ ] 3. Average [ ]
33	Give reasons for your answer in 32	

34	In which specific way(s) has this irrigation farming been of help to you?	Rank responses with 1st, 2nd, 3rd, 4th ……. Provision of employment [ ] Source of income [ ] Source of nutrition [ ] Provision of food security [ ] Others, specify [ ] ……
35	Does the irrigation help in livestock production?	1. Yes [ ] 2. No [ ]
36	If yes to 35, how?	Rank responses with 1st, 2nd, 3rd, 4th ……. Provision of feed [ ] Source of water [ ] Income to access veterinary service [ ] Others, specify……..
37	Does the livestock production help in irrigation farming?	1. Yes [ ] 2. No [ ]
38	If yes to 37, how?	Rank responses with 1st, 2nd, 3rd, 4th ……. Draft animals (farming, transportation) [ ] Sold to buy farm inputs [ ] Others, specify ……..
	What challenges do you face and how does that affect your farming?	
39		
	SECTION THREE: IRRIGATION FARMING AND MIGRATION	
40	Have you moved out of your community purposely to stay somewhere in the last one year?	1. Yes [ ] 2. No [ ]
41	If yes to 40, why did you move out?	Tick those that apply 1. For formal employment [ ] 2. For further education [ ] 3. For farming [ ] 4. For menial jobs [ ] 5. Others, specify
42	If yes to 40, did your migration affect the livelihood of your household?	1. Yes [ ] 2. No [ ]
43	If yes to 40, how?	Tick those that apply

		1. Remittances [ ] 2. Provision of Accommodation [ ] 3. Provision of employment [ ] 4. Reduced labour 5. Others, specify
44	Did any of the benefits of your migration help in irrigation farming?	1. Yes [ ] 2. No [ ]
45	Has anyone in your family moved out of the community purposely to stay somewhere in the last one year?	1. Yes [ ] 2. No [ ]
46	If yes to 45, why did the person move out?	Tick those that apply 1. For formal employment [ ] 2. For further education [ ] 3. For farming [ ] 4. For menial jobs [ ] 5. Others, specify …….
47	If yes to 45, did the person's migration positively affect the livelihood of your household?	1. Yes [ ] 2. No [ ]
48	If yes to 47, how?	1. Remittances [ ] 2. Provision of Accommodation [ ] 3. Provision of employment [ ] 4. Reduced labour 5. Others, specify
49	Did any of the benefits of the person's migration help in irrigation farming?	1. Yes [ ] 2. No [ ]
50	How often do you move out?	1. Annually [ ] 2. Biennially [ ] 3. Others, specify……..
51	Do you make more money when you move out?	1. Yes [ ] 2. No [ ]
52	Do you think it is more helpful in moving to other locations?	1. Yes [ ] 2. No [ ]
53	If yes, give your reasons	
54	If no give your reasons	

Thank you for your time and responses.

Appendix B: Focus Group Discussion Guide for Executives of Water User Groups

UNIVERSITY FOR DEVELOPMENT STUDIES
FACULTY OF PLANNING AND LAND MANAGEMENT
DEPARTMENT OF GOVERNANCE AND DEVELOPMENT MANAGEMENT
FOCUS GROUP DISCUSSION GUIDE FOR EXECUTIVES OF WATER USER GROUPS

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1. How does one get access to a plot for irrigation?
2. Are there conditions or rules to access a plot and which people qualify? (community members only, adults only, married men only, family heads only or anyone)
3. How are parcels or plots of land allocated for irrigation (people from the community and people outside the community if any)?
4. Do other people come into the community purposely for irrigation farming?
5. Do people leave the community during dry season because of challenges faced with the irrigation facility?
6. Do irrigation farmers or members of their household migrate often (in the last year)?
7. How does their migration affect irrigation farming?
8. How many people come from elsewhere to use the irrigation facility?
9. How does those who come into the community to farm affect irrigation?
10. How does those who leave the community (if any) affect irrigation?
11. How was the governing structure for the irrigation facility arrived at?
12. What is the current composition of the executives of the irrigation farmers?
13. What is their tenure of office?
14. How are they made executives?
15. What rules govern their positions and activities?
16. What are their functions?
17. What relationship do the executives have with external actors (DA, NGOs, GIDA, etc.)?
18. How is the scheme managed to ensure the dam is in good shape for continuous use?
19. Do you meet other stakeholders (NGOs, WWDA, MOFA) when you have issues beyond your reach?
20. Do you get solutions to your problems?

21. What does the Association do if their grievances are not addressed?
22. Is there any support given to one another insofar as the irrigation farmers are concerned?
23. Is there a ready market for the sale of your produce?
24. Are members able to store their produce in case of high yield?
25. What are the challenges you face with the facility?
26. What are the farmers' contributions towards management of the dam?
27. What is the maintenance schedule of the facility?
28. How much does it cost for operating and maintaining the facility?
29. Who bears the operation and maintenance cost?
30. What contribution do you make towards the maintenance?

Appendix C: Semi-Structured Interview Schedule for Ghana Irrigation Development Authority (UW/R)

UNIVERSITY FOR DEVELOPMENT STUDIES
FACULTY OF PLANNING AND LAND MANAGEMENT
DEPARTMENT OF GOVERNANCE AND DEVELOPMENT MANAGEMENT
SEMI-STRUCTURED INTERVIEW SCHEDULE FOR GHANA IRRIGATION DEVELOPMENT AUTHORITY (UW/R)

The researcher is a postgraduate student of the University for Development Studies pursuing an Mphil in Development Management. This study seeks information on the topic- **SMALL-SCALE IRRIGATION FARMING AND ITS EFFECTS ON RURAL LIVELIHOOD IN THE WA WEST DISTRICT.** Information given will solely be used for this research. You are also assured of full confidentiality, privacy and anonymity of any information that you provide.
Participating in this interview will attract no rewards and your participation in the study is solely voluntary. You are also free to discontinue your participation at any stage of the study. You are however commended for agreeing to participate in the study. You are kindly requested to answer the questions as frankly and openly as you can. Thank you.

YELIYIRI AND BALEUFILI COMMUNITIES

1. What are the objectives for the establishment of the Irrigation Scheme?
2. What is expected of GIDA in fulfilling the objective of the irrigation systems?
3. Are the systems performing to meet the expected results or to achieve the objectives?
4. What is the role of GIDA in these irrigation sites, especially in terms of their governance or management?
5. What challenges does GIDA face in its responsibilities?
6. How often do you visit these sites?
7. Are the number of visits enough to help the farmers make the best out of the facilities insofar as your duties are concerned?
8. What is the level of coordination and cooperation between the farmers and GIDA?

9. What are the major potentials and opportunities of the Baleufili and Yeliyiri dams?
10. What are the major weaknesses and challenges of the Baleufili and Yeliyiri dams?
11. How do you harness the potential of the dams for optimum utilization and high production?
12. How do you address some of the challenges and weaknesses of the farmers?
13. What are the major challenges they face?
14. What are the management structures of the dams?
15. Do the governance structures of the dams militate or help in advancing their utilization?
16. Do irrigation farmers put forward their challenges or grievances to the authority?
17. What is your relationship with other institutions (gov't, NGOs, etc.) in managing the irrigation schemes?
18.

NAME OF INSTITUTION	NATURE OF RELATIONSHIP	BENEFITS OF RELATIONSHIP	CHALLENGES OF RELATIONSHIP	WHAT CAN BE DONE TO IMPROVE THE RELATIONSHIP

19. What are the challenges and weaknesses the authority face in the execution of its task with regards to irrigation in the upper west region?

Appendix D: Semi-Structured Interview Schedule for Department of Agriculture, Wa West District (UW/R)

UNIVERSITY FOR DEVELOPMENT STUDIES
FACULTY OF PLANNING AND LAND MANAGEMENT
DEPARTMENT OF GOVERNANCE AND DEVELOPMENT MANAGEMENT
SEMI-STRUCTURED INTERVIEW SCHEDULE FOR DEPARTMENT OF AGRICULTURE, WA WEST DISTRICT (UW/R)

The researcher is a postgraduate student of the University for Development Studies pursuing an Mphil in Development Management. This study seeks information on the topic- **SMALL-SCALE IRRIGATION FARMING AND ITS EFFECTS ON RURAL LIVELIHOOD IN THE WA WEST DISTRICT OF GHANA.** Information given will solely be used for this research. You are also assured of full confidentiality, privacy and anonymity of any information that you provide.
Participating in this interview will attract no rewards and your participation in the study is solely voluntary. You are also free to discontinue your participation at any stage of the study. You are however commended for agreeing to participate in the study. You are kindly requested to answer the questions as frankly and openly as you can. Thank you.

YELIYIRI AND BALEUFILI COMMUNITIES

1. What is the structure of MOFA in the district?
2. What is the role of MOFA in these irrigation sites?
3. What challenges does MOFA face in its responsibilities?
4. How often do you visit these sites?
5. Are the number of visits enough to help the farmers make the best out of the facilities insofar as your duties are concerned?
6. What is the level of coordination and cooperation between the farmers and MOFA?
7. What are the major challenges irrigation farmers face?
8. What is your relationship with other institutions (Donor Organisations, NGOs, etc.) in helping irrigation farmers?

9. How do irrigation farmers benefit from government's flagship planting for food and jobs programme?
10. What is the level of coordination between MOFA and GIDA?
11. What can MOFA do to assist irrigation farmers to get the best out of their activities?