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EFFECTS OF SMALL SCALE IRRIGATION ON RURAL POVERTY REDUCTION IN THE UPPER EAST REGION: A CASE STUDY IN BOLGATANGA MUNICIPALITY

BY

DANIEL AKOLGO AWAREKALIYA (B.A POLITICAL SCIENCE)

UDS/MDS/0053/07

THESIS SUBMITTED TO THE DEPARTMENT OF AFRICAN AND GENERAL STUDIES, FACULTY OF INTEGRATED DEVELOPMENT STUDIES, UNIVERSITY FOR DEVELOPMENT STUDIES, IN PARTIAL FULFILLMENT OF THE REQUIREMENTS FOR THE AWARD OF MASTER OF PHILOSOPHY DEGREE IN DEVELOPMENT STUDIES

OCTOBER, 2014

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DECLARATION

Student

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

Candidate's Signature:..... Date:..24/10/14

Daniel Awarekaliya Akolgo

Supervisors'

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

Supervisors' signature: ..... Date: 24/10/14

Professor Seidu Al-hassan

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ABSTRACT

The Government of Ghana since independence has undertaken the construction of a considerable number of small-scale dams in the Upper East Region to increase water accessibility for small-scale irrigation. The main objective of this study was to examine the impact of improved agricultural water access and use of small-scale irrigation schemes on poverty reduction and food security. A semi-structured interviewer questionnaire was used to collect information from three purposefully sampled communities on: crops grown and irrigated; perception of poverty, food security; sources and means used to ensure food availability. A total of 235 farmers were surveyed. Of the 120 irrigation farmers who participated in the survey, more than half (57%) indicated that they engaged in irrigation farming to supplement their household food requirements, while almost a third (28%) indicated that through irrigation they could support their children's education. More than two-thirds (67%) of respondents reported having acquired household assets through irrigation farming. The main sources of income for irrigation farmers came from the sale of farm produce (84%), mostly from dry season irrigated crops, as compared to (13%) of rain-fed farmers. Almost all (94%, N = 112) of the irrigators reported that income earned from sales of irrigated crops was used to purchase food to supplement their rainy season staple crop production, followed by the payment of school fees (84%, N = 100) and health care expenses It can be concluded that the small-scale irrigation schemes, which provided access to irrigated agriculture for year-round crop diversification provide self-employment for participants and improve their household income and access to marketable food as well as other soc-economic benefits. The study therefore recommends that the existing small scale irrigation dams should be rehabilitated and the construction of new ones should be intensified to cover all areas in northern Ghana that have low lands for potential irrigation development.

. The Government also should play a direct role in extension service training and provision of other technical support services, like training on small-dam construction, scheme design and the production of manuals for design and management of micro-dams and water diversion structures.

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Last but not least, I am special gratitude to my wife, Doreen, and my lovely sons, Caleb and Phinehas and the entire Akolgo family for their prayers and support.

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DEDICATION

This work is dedicated to my wife Doreen, my two sons Caleb and Phinehas and the entire Akolgo family, especially my mother for her prayer support.

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LIST OF ACRONYMS

ADB	Asian Development Bank
BMA	Bolgatanga Municipal Assembly
DFID	Department for International Development
FAO	Food and Agriculture Organization
GDP	Gross Domestic Product
GSS	Ghana Statistical Service
IFAD	International Fund for Agricultural Development
IMF	International Monetary Fund
IWMI	International Water Management Institute
LACOSREP	Land Conservation and Smallholder Rehabilitation Project
MDG	Millennium Development Goals
MoFA	Ministry of Food & Agriculture
NDPC	National Development Planning Commission
SADA	Savannah Accelerated Development Authority
SSA	Sub-Saharan Africa
UER	Upper East Region
UNDP	United Nations Development Programme
URADEP	Upper Region Agricultural Development Project
USAID	United States Agency for International Development

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CHAPTER ONE

INTRODUCTION

1.1 Background

Despite over a century of debate and actions by individual countries and the international community aimed at transforming the livelihoods of the poor, poverty is still one of the greatest challenges facing the whole world today especially in developing countries. Extreme poverty is said to ravage the lives of one out of every four whiles about 1.2 billion people cannot meet their most basic needs of sufficient food everyday in the developing countries (Boon, 2004).

The number of people living on less than $1.25/day in Sub Sahara Africa (SSA) increased from 297 million in 1990 to 388 million in 2005, with an estimated marginal reduction to 356 million by 2015 (World Bank, 2009). Of the 1.2 billion people defined as dollar-poor (i.e. with a per capita household income or consumption level below US$1-a-day in 1985 Purchasing Power Parity [PPP]) terms, three-quarters lived in rural areas. According to the Food and Agriculture Organization (FAO) about 30 percent of the population in SSA is facing widespread chronic food insecurity, persistent hunger and associated high malnutrition, which are indications of poverty (FAO, 2009; FAO, 2008; Smith and Aduayom 2006). Poverty is broadly categorised into two distinct dimensions: absolute poverty; defined as "lack of access to a basket of basic survival needs" and relative poverty; that is the "lack of access to the level of resources accepted as normal in a society". It embraces issues such as powerlessness, deprivation, malnutrition, confidence and self-respect, poor health and education, social exclusion, vulnerability and lack of participation

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(United Nations Development Programme [UNDP], 1997; Ghana Statistical Service [GSS], 2007).

Poverty reduction has therefore been a central feature of the international development agenda for over three decades, and the last two decades have witnessed a tremendous progress in poverty reduction globally (Veltmeyer, 2010; Chen and Ravallion, 2008). This achievement has, however, been uneven with many developing countries experiencing little poverty reduction (Fosu, 2010). The World Bank (2009) warns that unless large-scale agricultural investment, along-side knowledge creation and dissemination are stepped up, food production in many of parts of Africa, will not keep pace with demand. Even though renewing the fight against poverty requires action on many fronts (Boon, 2004; IFAD, 2001), it is clear from the rural development literature that agriculture is considered as one of the best vehicles to reducing rural poverty (IBRD/World Bank, 2012; Meliko & Oni, 2011; Christiaensen & Demery 2007; Department for International Development [DFID] 2004).While most increases in agriculture production comes from biological yields, Narayanamoorthy (2004) noted that irrigation agriculture is one of the most important rural development investments that have both direct and indirect impact on poverty reduction and food insecurity in semi- arid countries.

The economy of Ghana is predominantly agrarian with about 80% of the country's agricultural output being produced by smallholder farmers (Asuming-Brempong et al., 2003; Ministry of Food and Agriculture [MoFA], 2010). Agriculture contributes more than 30% of the total Gross Domestic Product (GDP), employs about 50% of the labour force and is the largest export earner (Diao, 2010; MoFA,

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2010). Even though Ghana is endowed with vast agricultural land and water resources, the sector is still dominated by smallholder farm households. In addition, majority of these farmers are rain-fed dependent subsistence food crop producers with limited access to, and adoption of sustainable agricultural technologies. It is also on record that smallholder farmers constitute about 90 to 95% of the farming population of Ghana (Asuming-Brempong et al., 2003).

It is within this context that the Country's medium and long term agricultural policy is geared towards modernizing the sector as a necessary condition for ensuring food security and rural poverty reduction (MoFA, 2010; NDPC, 2010). Yet smallholder farmers continue to dependent largely on unpredictable rain-fed agriculture, with considerable variability across the country in terms of access to agricultural water (MoFA, 2010). Although irrigation holds the key to boosting agricultural productivity, less than one percent of the country's arable land in under irrigation, coupled with the poor performance of large and medium scale public irrigation schemes (Ghana National Commission for UNESCO, 2010; Namara et al., 2011). This means that there is significant scope for developing small scale multiple water user irrigation schemes to reach millions of smallholder farming households. Already Ghanaian farmers are familiar with a wide range of agricultural water management methods, employing private and communally managed irrigation systems in the form of dugouts and conventional small dam surface schemes (Evans, Giordano & Clayton, 2012).

Irrigation agriculture increases crop yields and controls drought risks, enabling smallholder farmers to improve their livelihoods through sustained food

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availability for household consumption and for sale (IFAD, 2006). Irrigated agriculture is also linked to poverty reduction through its multiplier effects on improved crop production, employment creation and increased farm income (Hussain & Hanjra, 2004). Sustainable irrigation systems afford farmers a second and sometimes a third cropping season, and thereby increasing crop diversification options for farmers. In addition to increasing overall production, irrigation increases the reliability and consistency of production (Smith, 2004). Arguably, reducing vulnerability to shocks and variability of production is extremely important for subsistence farmers because reduced vulnerability enables poor farmers to maintain their productive assets and avoid indebtedness (Burney et al., 2010; Zimmerman & Carter, 2003).

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There is growing body of evidence which suggests that small scale irrigation schemes managed by farmers directly benefit poor rural households better than other poverty-reduction interventions, and as a result improves more livelihoods compared to large-scale schemes (Chambers et al., 1989). Despite this, Van Koppen (1998) noted that small-scale irrigation schemes, which are usually dispersed and targeted at poor households, were not likely to attract significant external support, although they offer considerable potential for poverty eradication and equitable resource access.

1.2 Problem Statement

Successive governments since the 1950s and 1960s, have embarked on various agricultural programmes through the construction and rehabilitation of small reservoirs (dams) and dugouts to provide reliable water supplies to communities in the Upper East Region for domestic use, livestock watering, fishing and crop

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irrigation (Coche, 1998). The long term objective was to reduce the adverse impacts of the single unreliable rainy season on agricultural productivity (Coche, 1998; Blench, 2006). The Government's current policy on small scale irrigation is aimed at increasing smallholders' crop production by providing improved technology, infrastructure and institutional support (MoFA, 2011).

In the Upper East Region, the aim of improving access to irrigation infrastructure is to provide year-round employment, and increase smallholder agricultural productivity and incomes of farm households. Thus, over the years more small dams and dugouts have either been constructed or existing ones rehabilitated and converted into more structured small-scale irrigation schemes to provide reliable sources of water for irrigation purposes (MoFA, 2013; Blench, 2006; IFAD, 2006; World Bank, 1987). It is estimated that there are about 276 dams and dugouts in the region (MoFA, 2013), with 154 of them having land sizes ranging from 1ha to 35 ha (Liebe, 2002). The major irrigated crops under these schemes are tomatoes, leafy vegetables (ayoyo, bean leaves, bito [kenaf] leaves), pepper, onions and okro.

Thus, the availability of many and well spread small scale irrigation schemes throughout the region provide agricultural water throughout the year to a wider population and therefore have the potential of reducing rural poverty through many pathways. These pathways include employment creation, improved nutrition and food security, increased incomes of farm households that enable them to access health care, educate their children, and acquired physical productive and non-productive assets such as housing, agricultural implements and means of transportation.

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The construction and maintenance of small dams require comparably little expenditure, and therefore, the government may not have to play a more direct role in the construction and management of small-scale irrigation schemes, once farmers have realised the importance of these schemes. Experience from Kenya suggests that farmers do much better when they are assisted to construct, own and operate small schemes themselves (Purcell, 1997). It is evident that public large and small schemes in Ghana have performed very poorly over the years than private schemes, in which farmers feel they have more to benefit (Namara et al., 2011). Farmers usually have very high expectations in government built and control irrigation schemes, but are quickly disillusioned when things begin to get bad as schemes deteriorate (Nanedo, 2014).

But as noted by Bhattarai, Sakthivadivel & Hussain (2002), the nature and scale of feedback effects associated with irrigation access and their impacts on farm households' income and poverty reduction process are often not clearly understood or reported in irrigation literature. The tendency is for studies to focus more on the direct impacts of irrigation (increased crop yield and farm income), but not on indirect impacts like rural employment and some economic multipliers associated with the provision of irrigation in an area, including access to education, health care and acquisition of physical assets.

In addition, a wealth of literature exist investigating irrigation and its impact on poverty reduction and livelihoods in developing countries, but it is mostly from studies in Asia (see Lipton & Litchfield, 2003; Hussain & Hanjra, 2004; Hussain & Wijerathna, 2004). A few studies have also been carried out in Africa, but not much

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in Ghana (for instance, Chazovachii, 2012; Gebregziabher & Namara, 2008; Dillon, 2008).

The importance of the need for an empirical study on the connection between small-scale irrigation and poverty reduction through improved access to education, health care, rural employment and improved food security to provide evidence-based justification for more investments and support for small-scale irrigated agriculture in Ghana cannot be overemphasized. Two recent studies have provided the lead by investigating the impact of the Tono medium scale irrigation scheme vis-à-vis poverty reduction among end users (Pealore, 2012; Dinye & Ayitio, 2013). However, there is still dearth of knowledge on the rural poverty reduction impacts of the small community-managed schemes dotted across the region.

It is to contribute in filling this gap in knowledge that this study used the Dorongo, Sumbrungu and Winkogo community-based small-scale irrigation schemes in the Bolgatanga Municipality to assess the impact of small scale irrigation on rural poverty reduction in the Upper East Region.

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1.3 Research Questions

The main research question was: What is the impact of improved agricultural water access and use of small-scale irrigation schemes on poverty reduction and food security of smallholder farmers? To adequately answer the main research question, the following specific research questions were asked, in an attempt to achieve the study objective.

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1) What are the socio-demographic characteristics of irrigation beneficiaries and non-beneficiaries in the study communities?

2) What are the secondary (indirect) impacts of the irrigation schemes to the socio-economic lives of farm households?

3) What is the contribution of the irrigation schemes on improving household food security?

4) What is the contribution of the irrigation schemes on household incomes?

5) What are the problems encountered by farmers in irrigated agriculture?

1.4 Main Research Objective

The main objective of the study was to examine the impact of improved agricultural water access and use of small-scale irrigation schemes on poverty reduction and food security of smallholder farm households in the study area from the perspectives of farmers.

1.4.1 Specific Objectives

The specific objectives of the study were to:

1) Describe the socio-demographic characteristics of the irrigation farmers.

2) Identify the socio-economic benefit farmers derive from the irrigation schemes.

3) Assess the contribution of the irrigation schemes on improving household food security.

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4) Assess the contribution of the irrigation schemes on household incomes.

5) Assess the problems farmers encounter in irrigated agriculture.

1.5 Significance of the Study

There have been policy drives in the agriculture sector by successive governments to find answers to decreasing food production and reduce poverty particularly among the rural poor (GPRS 2006-2009). The expansion of irrigation into the northern regions of Ghana was long perceived as a policy strategy to break the evil marriage of unreliable rainfall conditions, low agricultural technology use and low agricultural productivity. However, attention in much of the Ghanaian literature and more particularly in the political arena regarding the operations of the Small Scale Irrigations Schemes in the country has not been that evident.

The study therefore sought to unearth the fact that although there is still high rural poverty among smallholder farmers in the Upper East Region, small scale irrigation schemes like those under study could contribute tremendously to rural poverty reduction in line with government poverty reduction strategies through enhancing agricultural production.

The study is a timely response to the need by government to improve the production of food crops in order to reduce poverty. The arguments and evidence that would be presented in this research to a large extent will influence policy makers in the design of appropriate policies and programmes that can help address poverty issues especially government plans on the implementation of the Savannah Accelerated Development Authority (SADA) document which is expected to bring

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about rapid socio-economic development to the three northern regions of Ghana through agriculture development.

The findings of the study were also intended to encourage farmers to pursue small scale irrigation as an alternative farming practice (dry season farming) in their quest to improve on their incomes and reduce poverty level. In spite of government policies and strategies over the years aimed at reducing poverty in the three northern regions, a snapshot of the livelihoods of many people in the region who are heavily dependent on rain fed agriculture is not one of normal poverty but a critically precarious existence among the food crop farmers who are said to be affected in the incidence of poverty in the northern regions of the country. It is in this notion that this study wishes to contribute to the discussions on the development of irrigation as a led strategy in the fight against poverty in Northern Ghana where rainfall shortage is the most severe in the country.

Finally, the findings of the study will contribute to bridging the gap in the body of knowledge and therefore help guide future research as far as the small scale irrigation and poverty reduction is concerned.

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1.6 Scope and Limitations of the Study

The geographical scope of the study was in the rural Dorongo, Sumbrungu and Winkogo communities in Bolgatanga Municipality of the Upper East Region. Though the target group was the irrigated farmers, data on rain-fed farmers was also gathered at the communities. The focus of the study was to assess the contribution of small-scale irrigated agriculture to household income, food security and other socio-economic benefits in three selected community-based small scale irrigation schemes.

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However, the study encountered a number of limitations. One of the limitations encountered was the difficulty in getting reliable data, especially on household landholding, volume of crop production, income, and livestock holdings. Farmers could only recall the most recent information when asked to provide information on most of these variables. It was evident during the fieldwork that some respondents were very reluctant to give information on variables related to their socio-economic status and they were therefore likely to under-report on these variables. Following this limitation and of course time constraint the study however gathered data on only the 2012 year cropping season for analysis.

1.7 Organization of the Study

The study is organized in eight chapters: Chapter one provides an introduction to the study. Chapter two presents the review of relevant literature around the topic and specific objectives, and defines some underlying concepts and terminologies used in the study. Chapter three provides the methodology of the study highlighting the methods adopted. Chapter four presents the results and discussion on the characteristics of study participants and their perceptions on poverty and its causes; chapter five on some irrigation and poverty reduction linkages, with a focus on the indirect impacts in terms of facilitating access to health care, education, employment creation, assets acquisition and reduction of youth migration. Chapter six presents the results and discussion on irrigation and food security inter-relationships, chapter seven on the impact of irrigation on household incomes, and chapter eight contains the summary of the study findings, conclusions and recommendations.

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CHAPTER TWO

LITERATURE REVIEW

2.1 Introduction

This chapter presents a review of related literature (published and grey) on the topic and around the specific objectives. It covered definitions of some underlying concepts and terminologies used in the study. Main sections of the review include; the concept of poverty, its dimensions and measurement; poverty trends and reduction strategies in Ghana with particular reference to rural poverty in the three poorest northern regions; water management, irrigation development and agriculture inter-relationships; and the impact of irrigation on poverty reduction.

2.2 Definitions and Concepts

This section defines some underlying concepts and terms used in the study.

2.2.1 What is Rural

Since the focus of this study is on assessing the impact of irrigation agriculture on rural poverty reduction, it is essential to define what is rural. In practice, two main methodologies have been used to define rural. The first methodology is to use a geopolitical definition. First, urban is defined by law as all of the state, region, and district capitals (centers), and by exclusion all the rest is defined as rural.

The other commonly adopted methodology is to use observed population agglomeration to define rural-urban. The rural/urban population is defined according to the national census definition of each country (United Nations [UN], 2012). In Ghana, localities (i.e. settlements) with less than 5,000 people are classified as rural

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(Ghana Statistical Service [GSS], 2012). In other countries like Uganda, an agglomeration of only less 100 inhabitants constitutes a rural settlement, while in Nigeria the minimum agglomeration for rural areas is less 20,000 people. The wide variation among national definitions of the concept of "rural" seriously impairs international comparability of urban/rural distribution (UN, 2012).

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2.2.2 The Concept of Poverty

While there is world-wide agreement that poverty reduction is an overriding goal of development policy, the concept of poverty is not all that easy to define in view of the fact that poverty is a highly complex problem, with multiple causes and manifestations. There are a cluster of different overlapping meanings depending on what subject area or discourse is being examined (Spicker, Leguizamon & Gordon, 2007). Sen (1987, cited in Ravallion and Bidani [1993]) defined 'poverty' as the lack of certain "capabilities", such as skills and physical abilities and being able to participate with dignity in the society around one. The capabilities are absolute, but the commodities needed are relative. The World Bank (2001) simply defined poverty as "pronounced deprivation in well-being", where well-being can be measured by an individual's possession of both tangible and intangible assets such as income, health status, nutrition, education, physical assets, shelter and certain rights in a society, such as freedom of speech (Haughton & Khandker, 2009; World Bank, 2001).

In this connection, Chambers (2006) contends that if the prime goal and measure of development over the years has been to reduce, alleviate or completely eliminate extreme poverty, then it is important to "know what poverty is" from the perspectives

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of the poor. In other words, "what poverty is taken to mean depends on who asks the question, how it is understood, and who responds" (Chambers, 2006:3).

2.2.3 Poverty Trends in Ghana

Poverty trends in Ghana have been measured both through formal surveys and also through qualitative consultations with the poor through which the household consumption/ expenditure levels, and establish nutrition-based income is determined for measuring poverty lines, (GSS, 2008 & 2007).

According to GSS (2007), the percentage of Ghanaians defined as poor (poverty incidence) fell from 39.5% in 1998/1999 to a little under 28.5% in 2005/2006. During the same period, the lower (extreme) poverty line fell from 26.8% to 18.2%. Whilst this is a positive trend, the impact was not uniformly spread across the country. The pattern of poverty reported in GLSS 5 (2005/06) revealed sharp differences in poverty levels between geographically adjacent regions. Whereas Accra and the rural forest ecological zones recorded a substantial decrease in poverty, the rural savannah areas (Northern, Upper East and Upper West Regions) experienced marginal reductions in poverty when measured against the lower poverty line (GSS, 2008). However, in addition, poverty levels in rural savannah and among food crop farmers were much higher than in rural coastal and forests areas (GSS, 2007). Confirming the poverty situation in the northern regions, the Ghana Living Standards Survey reported that seven out of ten people were extremely poor in the Northern Region, in the Upper East Region eight out of every ten people were below the lower poverty line, while in the Upper West Region nine out of every ten people live below the poverty line. Adult illiteracy rate is also prevalent in this part of the

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country; the adult illiteracy rate of 75.6% for that of the Upper West Region is far higher than the national average of 45.9%. While the malnutrition rate of 25% amongst the children in the region is the highest in the country (GSS, 2008; Songsore, 2011).

2.3 Rural Poverty in Ghana

As noted in the previous section, rural poverty remains widespread in the dry savannah regions that cover roughly two thirds of Ghana's northern part. Unlike the south, where there are two growing seasons, the northern dry lands are drought-prone and present relatively few economic opportunities (IFAD, 2013). While Ghana's overall poverty rate has declined, the three northern regions have seen only marginal decreases. Rural poverty rates in the three northern regions are two to three times the national average and as a result chronic food insecurity remains a critical challenge in the three regions (IFAD, 2013; GSS, 2008).

Small-scale farmers in Ghana's poor rural areas have very limited access to the assets that would facilitate a shift from subsistence farming to modern, commercial agriculture. Major constraints to their livelihoods include a lack of infrastructure and equipment – such as appropriate irrigation technologies, food for storage and processing facilities as well as poorly functioning markets (IFAD, 2013).

In addition, population pressure and short fallow periods lead to soil erosion, loss of fertility and land degradation, all of which pose a long-term threat to farmers' livelihoods and incomes. With few employment options available, many rural young men and women in the north migrate from their villages to urban centres in search of non-existent jobs (Al-Hassan & Diao, 2007).

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2.4 Water Management and Agriculture

Unreliable access to water for consumption and productive uses is a major constraint for increase agricultural productivity and rural development in dry savannah parts of Ghana and elsewhere in Sub-Saharan Africa (Food and Agriculture Organization [FAO], 2012). For millions of smallholder farmers, fishers and herders, water is one of the most critical production assets, considering that agriculture remains the main source of employment and livelihood for the rural poor. In this respect, increasing and improving investments in agricultural water management to support smallholder farmers should be the central focus of any development strategies for reducing rural poverty (FAO & IFAD, 2008).

Like elsewhere in Sub-Saharan Africa, small-scale irrigation is very promising in the region and it can promote rural food security, poverty alleviation and adaptation to climate change. It enables households to generate more income, increase their resilience and, in some cases, transform their livelihoods (Tucker & Leulseged, 2010).

2.4.1 Classification of Irrigation Schemes

Irrigation schemes could be classified as either formal or informal (indigenous) depending on the type of development and management structure. A formal irrigation scheme as used by Carter (1993) refers to "the development and management of irrigated agriculture in a structured formal way" usually by government or an external agency. An informal or indigenous irrigation on the other is defined as a scheme which is under local responsibility, controlled and operated by the local people in response to their felt needs.

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The main criteria frequently used for the classification of irrigation schemes are the irrigated area, scale of operation and management types. The most commonly used classification is small, medium and large scale irrigation schemes, though the interpretation of these categories may vary from country to country (Smith, 1998). In Ghana, irrigation schemes are generally categorised as small, medium or large based principally on size. Scheme sizes of up to 200 ha are regarded as small; sizes between 200 and 1,000 as medium and sizes greater than 1,000 ha are regarded as large schemes (Kyei-Baffour & Ofori, 2006).

Each of these irrigation schemes has the potential for poverty reduction but must be said that its impact on the poor would depend on different social, environmental and economic costs which may differ across different groups as well as the irrigation technology itself, their position along the distribution system, the institutional rules governing access to water and maintenance of water systems and their ability to complement irrigation with other agricultural inputs (which includes access to land, credit, seeds, fertilizer etc).

Small scale irrigation involves irrigation activities on small plots, comprising a small number of farmers, using relatively small reservoirs rivers, dams or a cluster of wells controlled by the farmers using technology they can operate and maintain. In this study, the reservoirs in focus are the small dams that have been constructed and fitted with the irrigation facilities for use by the communities in question.

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2.5 Concept of Small-scale Irrigation

Small-scale irrigation systems are defined as schemes that are controlled and managed by the users (farmers). In other words, major management and operational decisions on irrigation and agriculture are made by the farmers. In many cases, small-scale schemes are developed, operated and maintained by individuals, families, communities, and local government authorities or NGOs, independent of direct government involvement (W. Bart, 1996). In the context of this study, small-scale irrigation refers to the small dams and doughnuts that were developed and/or rehabilitated in the upper east region under various poverty reduction agricultural interventions and transferred to community water users for operation and management.

2.6 General Overview of Irrigation Development

Irrigated agriculture is defined as agriculture where the supply of water is increased by artificial means, involving the use of water control technology and including drainage to dispose of excess water (IPTRID, 1999). In this context, irrigation is widely defined as the practice of applying water to the soil to supplement the natural rainfall and provide moisture for plant growth (Uphoff, 1986; Dupriez & De Leener, 2002). The source of irrigation water is usually surface water or groundwater. Surface water is obtained in ponds, lakes, rivers, streams and the sea.

Irrigation has been practiced in many parts of the world for thousands of years. Irrigation systems seem to have developed separately and independently at least in three major locations. According to Zewdie et al. (2007) irrigation has been practiced in Egypt, China, India and other parts of Asia for a long period of time.

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The importance of irrigation in overcoming the uncertainty associated with rain-fed agricultural production and productivity, particularly for rural poverty reduction, has long been recognised worldwide (Breisinger et al., 2011; Dittoh et al., 2010; You et al., 2010; World Bank, 2007; FAO & IFAD; 2008; IPTRID, 1999). Irrigation when well managed can increase the productivity of the same piece of land year-round, thus increasing production. Irrigation development also ensures that there is good drainage of flood prone areas (MoFA, 2010).

2.7 Irrigation Development in Upper East Region

In recent decades, weather uncertainties have had great adverse impact on Ghana's agriculture and even though irrigated agriculture is well known to be important it is yet to make significant contribution to Ghana's agricultural development. Currently, irrigation contributes only less than 3% of the country's agricultural production (Breisinger et al, 2011). Only about 11,000 hectares of land (out of a potential irrigable area of 500,000 hectares) have been developed for irrigation and even the developed area is largely underutilized due to institutional, management, input and other constraints (MoFA, 2010).

Formal irrigation was introduced to the Upper East Region in the early 1950s when small dams were built for livestock watering, vegetable production in the dry season and for soil conservation. These were built and controlled by government through the Department of Agriculture or the Irrigation Development Authority (IDA) (Agyare et al., 2008). Apart from the two medium scale irrigation schemes at Tono and Vea, the Region has scattered small dams for community irrigation and animal watering. One estimate put the number of such reservoirs at about 160, with

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irrigable area ranging from 1 to 36 hectares (Liebe, 2002). Their reservoir capacities also range from 1.0 million down to 50,000 m^3. In addition, there are more than 70 dugouts usually constructed by borrowing earth material from the adjacent relatively flat terrain, mainly for livestock watering and other domestic water uses (Agyare et al., 2008).

Indigenous irrigation methods for dry season crop production on small plots fenced off with thorn bushes or stalks along valley bottoms, seasonal rivers and other water bodies for vegetables production (mainly tomatoes, onions and peppers) also have long tradition in the Region. Irrigation water is obtained from shallow wells dug within the fenced area or fetched with buckets, gourds or calabashes directly from the water body. In some cases the wells are dug within dried river beds or lowland ((Agyare et al., 2008).

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2.8 Irrigation and Poverty Reduction

Extensive empirical evidence suggests that irrigation projects have positive impacts on agricultural production and the reduction of poverty for farmers (Dillon, 2008; Kissawike, 2008; Lipton 2007; Bhattarai & Narayanamoorthy, 2004; Hussain & Hanjra 2004; Bhattarai, Sakthivadivel & Hussain. 2002; von Braun, Puetz & Webb, 1989).

Some of the existing literature on irrigation and its impact on poverty reduction are based on empirical research, with a focus on specific geographic locations, particularly in South East Asia. These studies use primary or secondary data and are methodologically rigorous. The second group of available literature is based on

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perceptions and logically reasoning arguments (e.g. Lipton et al. 2003), while the third type of literature is based on project evaluation, which may be biased towards funding Agency interest (Hussain & Hanjra, 2004). Among these, one of the studies that attempt to deal with irrigation poverty linkages comprehensively is (Hussain & Wijerathna, 2004), a study that covered six major Asian countries (i.e., Pakistan, India, Bangladesh, China, Vietnam and Indonesia).

Hussain and Wijerathna (2004) argued that irrigation reduces poverty both directly and indirectly, where the direct impacts are realized through labour and land augmentation effect that ultimately translates to improved productivity, employment, income and consumption, while the indirect impact is achieved through enhanced local economy and improved welfare at macro level.

Most of these studies on the impact of irrigation on poverty reduction are classified as comparative analysis, such as before and after, with and without or more or less comparisons. Hussain and Hanjra (2004), which is one of the descriptive/comparative studies, attempted to establish the irrigation-poverty linkage, and argued that access to irrigation reduces poverty. Hussain (2004) used primary data to make another comparative analysis of irrigation impact on household income in the marginal areas of Pakistan, where he concluded that small-scale irrigation is positively correlated with household income as well as reduces poverty. Similarly, Bhattarai and Narayanamoorthy (2004) used both cross-section and time series data to study the effect of investment in irrigation on poverty reduction in India, where they found that investment in irrigation as compared to investment in rural literacy was more effective in poverty reduction. Huang et al. (2005) used household level

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cross sectional data employing multivariate analysis, and found a strong positive correlation between access to irrigation and household income, leading to poverty reduction and equitable income distribution.

In Africa, Gebregziabher and Namara (2008) in a study investigating the impact of investing on small scale irrigation as a poverty reduction strategy in Ethiopia, found that irrigators had more diversified income sources than non-irrigators and that overall the poverty incidence (i.e., the proportion of poor households) among irrigators in the study sample was significantly lower than that of non-irrigators. Similarly, Dillon (2008) in a study in northern Mali found that small-scale irrigation projects can have significant positive impacts on household consumption, agricultural production, and nutrition, and by extension household level poverty reduction. In addition, Chazovachii (2012), in a study on the impact of small scale irrigation schemes on rural livelihoods in Zimbabwe reported that irrigators were able to educate their children as compared to non-irrigators. Of course, an investment in education is one of the surest long-terms ways of getting out of the poverty.

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Despite the reported positive impacts of irrigation agriculture on poverty, the literature on irrigation and its impact is polarized. For example, different studies which mainly used aggregated data (e.g. Fan, Zhang & Zhang, 2002; Jin et al., 2001; Fan, Hazell & Thorat, 1999; Rosegrant & Evenson, 1993) have found negative and/or weak relationship between irrigation and agricultural productivity implying negative or no impact on household income and poverty reduction at large. According to Rosegrant and Evenson (1993), for example the effect of irrigation on agricultural

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productivity in India was found to be negative. Again, Jin et al. (2001) used aggregated nation-wide data of China's major crops but did not find a relationship between irrigation and total factor productivity (TFP). On the other hand, Fan et al. (2002) made a comparative analysis of impact of public expenditure in irrigation, research and development, road, education, electrification and rural telephone networking, where "investment in irrigation was found to have the least impact on both production and poverty alleviation". Most of the studies that used aggregate data could not identify a positive contribution of irrigation to poverty reduction, implying that the direct effect of irrigation could be undermined by other factors which could have been observed at household and/or plot level.

In general, the lack of consensus regarding the linkages between irrigation and poverty reduction seems to mirror the general debate regarding the role of investment in agriculture. For instance, Christiaensen, Demery and Kuhl (2006) argued that although the majority of poor people in developing countries, especially in Sub-Saharan Africa (SSA), depend directly on agriculture for their livelihood, there is no common view about the role of agriculture in economic development and poverty reduction. For example, the dual economy model inspired by Lewis in the 1950s, argued that resources have to be diverted from agriculture to the industrial sector, while a positive view that emerged in the early 1960s argued about investment in agriculture and its contribution to economic growth and poverty reduction is more than an equal amount of investment in non-agriculture (Christiaensen et al., 2006). The experience of the Green Revolution in Asia, where traditional agriculture was rapidly transformed substantiates the role of investment in agriculture in economic

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growth and poverty reduction (Christiaensen et al., 2006). Despite the lack of consensus, empirical evidences show that in areas where irrigation is widely used, agricultural yields and household income are higher, and less poverty and undernourishment are observed (FAO & IFAD, 2008, Asian Development Bank [ADB], 2004; Lipton & Litchfield, 2003).

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2.9 Irrigation and Food Security

The concept of food security has become a global concern, and evolved through a sequence of definitions and paradigms. Weingärtner (2009) notes that the concept has evolved and continue to evolve over the years with changing global food and nutrition dynamics, but generally the evolution has centered around five major chronological milestones, which are; (1) the need to dispose of food surplus that were produced in the developed countries, especially in the USA and Canada, in the 1940s and 50s, (2) the concept of food for development introduced in the 1960s to reduce developing countries over reliance on food hand outs; (3 The food crisis of 1972/74 led to the need for food security insurance schemes, which were developed in the 1970s to assure international access to physical food supplies; (4) the need to widen the scope of food security issues in the 1980s; and (5) the shift to freedom from hunger and malnutrition adopted in the 1990s.

Household food security is multi-faceted and has complex interactions with various factors. Food security is defined in terms of four main dimensions: physical food availability, economic and physical access to food, food utilization and the stability of the first three dimensions over time (FAO, 2008). The combination and interaction of these elements represent household food security. Climate variability,

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natural disasters as well as socio-political instability can affect all four dimensions of food security at any particular time (FAO, 2008).

This study adopts the most common and widely accepted definition given at the World Food Summit held in 1996 as: Food Security' is achieved when it is ensured as "all people, at all times, have physical, social and economic access to sufficient, safe and nutritious food which meets their dietary needs and food preferences for an active and healthy life" (World Bank, 1996).

Food security is generally assessed in terms of three component concepts: namely Food Availability, Food Access, and Food Utilization, in addition to Food Stability, which are briefly explained (van Haeften, Anderson, Caudill & Kilmartin, 2013).

Food Availability means that food is physically present because it has been grown, processed, manufactured, and/or imported. For example, food is available because it can be found in markets and shops; it has been produced on local farms or in home gardens; or it has arrived as part of food aid. This refers to all available food in a geographical location, and includes fresh, as well as packaged, food. Many factors can affect availability of food directly or indirectly. For instance, food availability can be affected by disruptions to the food transportation and production systems, due to bad and inaccessible road networks, conflicts, crop failure. A switch from food crops to cash crops, changes in import and export tariff regimes. These occurrences can influence the amount of food availability in an area. In addition, food availability is dependent upon seasonal patterns in food production and trading.

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Food Access: refers to the way in which different people obtain available food. Normally, the way of accessing food is through a combination of means. This may include: home production, use of left-over stocks, purchase, barter, borrowing, sharing, gifts from relatives, and provisions by welfare systems or food aid. Food access is ensured when everyone within a community has adequate financial or other resources to obtain the food necessary for a nutritious diet.

Food access also depends on various factors like household's available income and its distribution within the household, as well as on the price of food. It also depends on markets. Food access can be negatively influenced by unemployment, physical insecurity (e.g. during conflicts), loss of coping strategies, such as the collapse of safety-nets which once protected people on low incomes.

Food Utilization: is the way in which people use food. It is dependent on a number of inter-related factors: the quality of the food and its method of preparation, storage facilities, and the nutritional knowledge and health status of the individual consuming the food. For example, some diseases do not allow for optimal absorption of nutrients, whereas growth requires increased intake of certain nutrients.

Food utilization is often reduced by factors such as endemic disease, poor sanitation, lack of appropriate nutritional knowledge, or culturally-prescribed taboos, especially related to gender, that affect a certain group's or family member's access to nutritious food. Food utilization may also be adversely affected if people who have limited resources for preparing food, for example due to a lack of fuel or cooking utensils.

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Food Stability: To be food secure, a population, household or individual must have access to adequate food at all times. They should not risk losing access to food as a consequence of sudden shocks (e.g. an economic or climatic crisis) or cyclical events (e.g. seasonal food insecurity). The concept of stability can therefore refer to both the availability and access dimensions of food security.

Burney et al (2010) notes that promoting irrigation can reduce poverty as well as increase food security through consumption of food produced directly under irrigation or income earned from sale of irrigated crops used to buy food stuffs. The main crops cultivated under irrigation in the three communities included leafy vegetables, and it is expected that the consumption of vegetables will increase among farm households with access to irrigation compared to those without. Income earned from the sale of irrigated crops could also be used to buy food items when stable food crop production under rain-fed is not enough for home consumption throughout the year.

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2.10 Conceptual Framework

The conceptual framework for this study is presented in figure 2.1. It shows a schematic representation of the transmission pathways between irrigation and poverty reduction. Five key inter-related dimensions of the relationship between access to reliable agricultural water and rural poverty reduction have been identified. The dimensions are production, income/consumption, employment, vulnerability/food security, and overall welfare (Figure 2.1).

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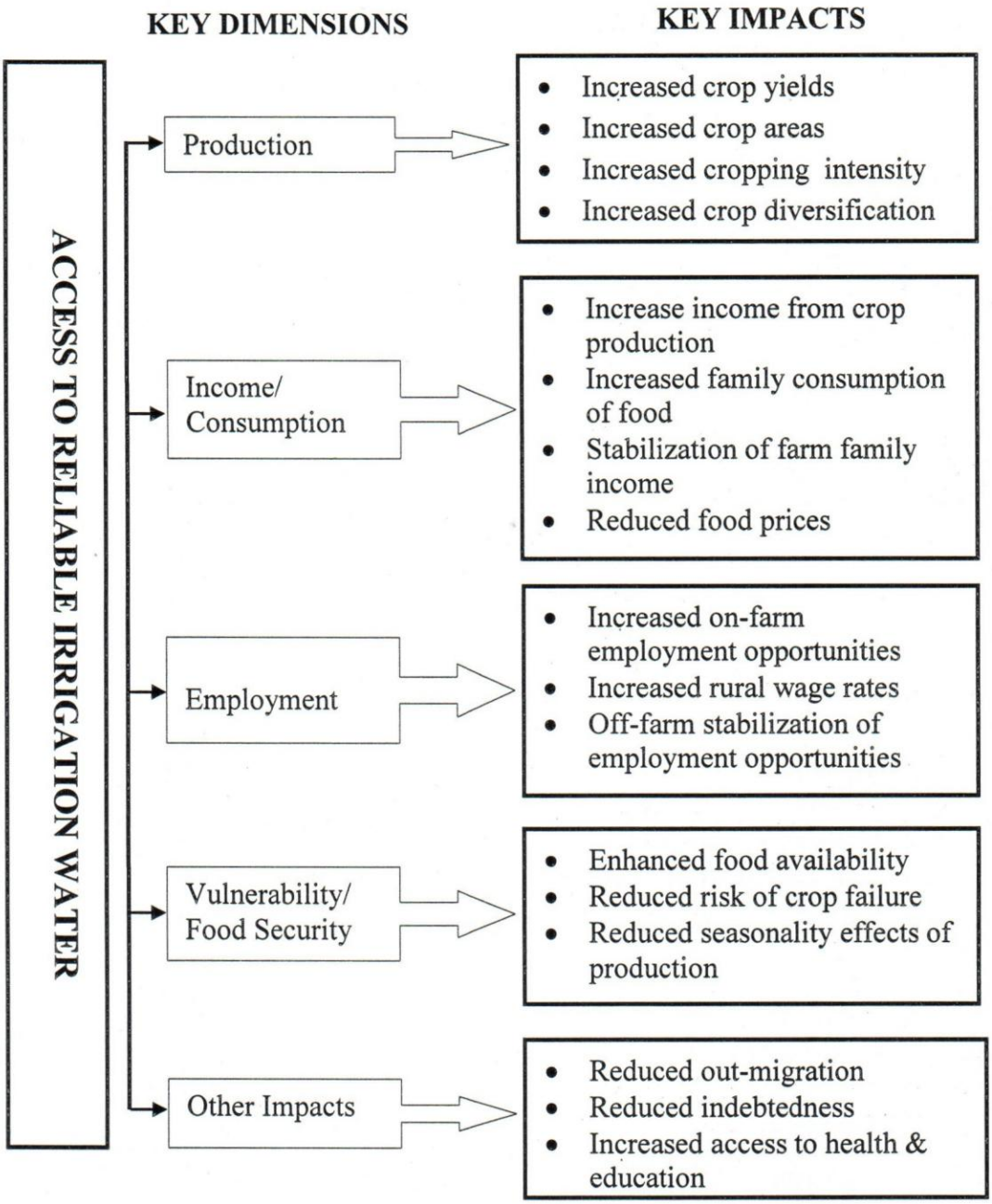

Figure 2.1: Conceptual Framework (Adapted from Hussain & Hanjra, 2004)

2.11 Summary

From the literature, it appears the task of defining poverty has been left to economists, who have narrowed the concept to what is measurable. Other academics and development practitioners have realized and shown that non-economic

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considerations are, often more or at least equally, important to the poor and therefore need to be integrated into the poverty concept. It is therefore, not surprising that the absolute poverty concept, based on consumption rather than income, is the basic concept applied in most definitions of poverty. This implies that the goal of most poverty reduction strategies is to help the poor to raise their incomes to levels exceeding the poverty line, despite increasingly inequalities which further entrench poverty. Ghana has made greater strides towards poverty reduction within the last two decades, though the impact has been uneven throughout the country. The poverty situation in the predominantly dry agrarian three northern regions has remained relatively higher and precarious, calling for pragmatic measures to reverse the situation.

Water is a vital resource for agricultural production and livelihood activities, and many developing countries have promoted water resources development within the last five decades to boost crop production and improve social outcomes. It is evident that reliable agricultural water/irrigation is regarded as a powerful factor for providing food security, protection against adverse drought conditions, increased prospects for employment and stable income, through providing farmers with greater opportunity for adopting new technologies, multiple cropping and crop diversification.

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CHAPTER THREE
STUDY AREA AND METHODOLOGY

3.1 Introduction

This chapter begins with the background description of the study area in terms of its location, demographics, topography, climate, vegetation and soils as well as the selected irrigation schemes for the case study. It then presents the general approach to the research methodology research design which outlines the entire research process of sampling, methods of data collection and the specific techniques to be applied to collect data in the field and well as the instruments that would be used to analyze the data.

The study was conducted in the Bolgatanga Municipality, which is the administrative capital of Upper East Region of Ghana. It is therefore important to describe and highlight some characteristic features of the Municipality relevant to the study.

3.2 Study Area

3.2.1 Geographical location and demographic characteristics

The Bolgatanga Municipality is centrally located in the Upper East Region, and falls approximately between latitudes 10°30' and 10°50' North and longitudes 0°30' and 1°00' West (see figure 2). Bolgatanga doubles up as both the municipal and regional capital. The Municipality is bordered to the north by the Bongo District, south and east by the Talensi and Nabdam Districts, and to the West by the two Kassena-Nankana Districts (West and East). It covers a total land area of about 729 km^2. It is one of two municipalities (the other being Bawku Municipal), which together with 11 other districts constitute the Upper East Region of Ghana (BMA,

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together with 11 other districts constitute the Upper East Region of Ghana (BMA, 2012; UNDP, 2010). The population density is relatively higher than national figures, with much of it clustered around the municipal capital. The Municipality has a total of 213 communities with a 2010 population of 131,550, of which 62,783 are males, representing 48 percent and 68,767 females, representing 52 percent. About half (50%) of the population is rural and 44 percent under age 18 years (GSS, 2012). The ethnic composition of Bolgatanga is cosmopolitan, but the indigenes are the Gurune speaking people.

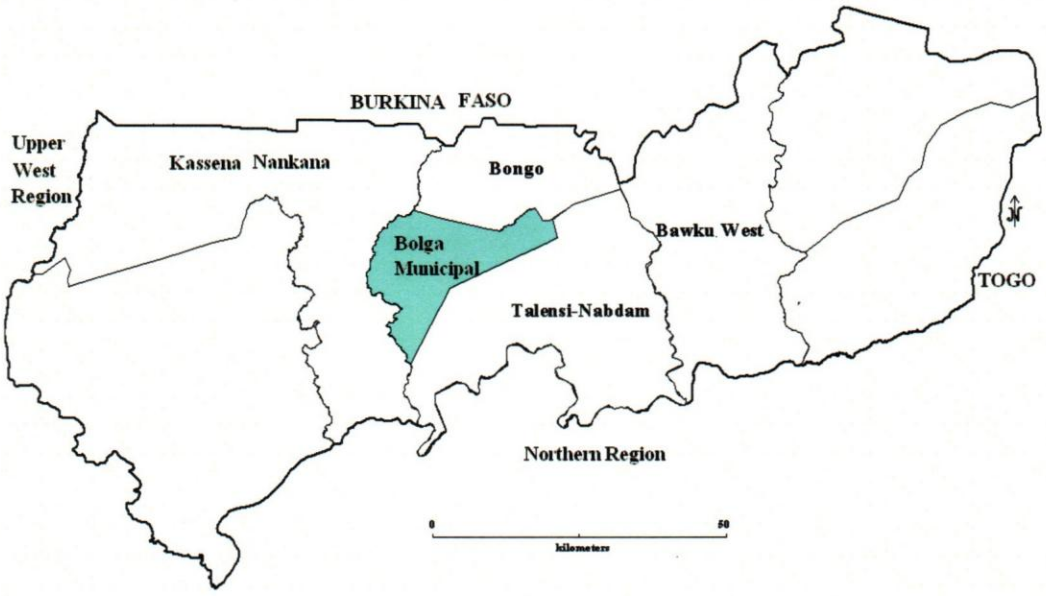

Figure 3.1: Sketch Map Showing Bolgatanga Municipality (Saaka, 2012)

3.2.2 Topography and Drainage:

The topography is made up of gentle slopes, with some isolated rock outcrops and uplands. Part of the Vea medium-scale irrigation project covering 850 hectares is located in the northern part of the municipality. The rock formation is the Birimian Tarkwaian and Voltaian rocks of Ghana; and there is evidence of the presence of

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by the White and Red Volta Rivers and their tributaries as part of the larger Volta River Basin (BMA, 2012).

3.2.3 Climate and Vegetation:

The climatic regime is semi-arid with two distinct seasons - a wet season that lasts from May to October and a long dry season that stretches from October to April. The mean annual rainfall is about 950 mm, while maximum temperature could go as much as 45°C in March and April with a minimum of 12°C in December. The natural vegetation is that of guinea savannah woodland consisting of short deciduous trees widely spaced and a ground flora, which gets burnt or scorched by sun during the long dry season. The most common economic trees are locust ('dawadawa'), shea, baobab, whitethorn (acacia) and kapok, with a ground cover of perennial grasses during the wet season. However, much of the land area is an extreme anthropogenic landscape as the natural tree cover has been severely depleted. The municipality has a forest reserve (Tankwiddi East Forest Reserve), which protect some water bodies in the area (BMA, 2012; Blench, 2006).

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3.2.4 Agriculture:

The economy of the Bolgatanga Municipality is largely dependent on agriculture and agro-based businesses. Agriculture accounts for more than 50 per cent of economic activities of the inhabitants, and it is the main occupation and source of livelihood of the rural poor. Seventy percent (70%) of the total land area of municipality is cultivated. There are 14,145 agricultural households with an average of six persons per household and average land holding of between 1.0 and 3.0 ha (BMA, 2012). The challenges of trying to increase agricultural output in the

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municipality include; short, erratic and unpredictable rainfall pattern; fewer small scale irrigation infrastructure; and environmental degradation.

Typical crops cultivated are cereals (millet, sorghum, rice and maize), legumes (groundnuts, cowpea, soybean and Bambara beans), and vegetables (tomatoes, pepper, okro, onion, garden eggs and leafy vegetables). The major staple crops are millet, sorghum and Frafra potatoes and the cash crops are maize, rice, groundnuts and sweet potatoes. The outputs of all these crops have followed the rainfall pattern such that as at 2008, about two-thirds of residents suffer food shortages during the year (UNDP, 2010).

Dry season farming plays a significant role in the agricultural production activities of the municipality. Vea Irrigation Project and a number of small scale irrigation schemes located in the municipality facilitate dry season farming. For example, the irrigation dams provide a total of about 815.5 ha for irrigated farming during the dry periods; the Vea project alone contributes about 637.5 ha of land for irrigated farming, while the small-scale dams provide a total irrigable area of about 78 ha. In addition, there exists potential of about 500 ha for water pump irrigation along the banks of the White Volta from which many farmers mostly grown cash crops. Livestock and poultry rearing is the second most important occupation after crop production. Most farmers are engaged in the rearing of at least one type of livestock and poultry. Livestock and poultry play important socio-cultural roles, apart from supplying the protein needs of the people as well as a source of income for farmers, especially when there is crop failure (MoFA, undated). The most common activity in the case of fishing in the municipality is fish hunting, which is carried out

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in the few water bodies scattered throughout the municipality. Acquaculture is not very common. In general, women mostly do fish processing and sell in the market (UNDP 2010).

3.3 The Case Study of Small-scale Irrigation Schemes

3.3.1 The Dorongo Scheme

The Dorongo irrigation scheme is located about 3 km along the Bolgatanga-Sherigu road west of Bolgatanga. The small reservoir and irrigation scheme were constructed in 1962 and rehabilitated between June 2002 and August 2003 under the Upper East Region Land Conservation and Smallholder Rehabilitation Project (LACOSREP) phase II project. The dam has an estimated storage capacity of about 0.24 million cubic meters (MCM) and a maximum surface area of 15 ha with a maximum depth of approximately 6m at maximum flooding. The catchment area is about 112 ha and the total irrigable area of about 10 ha. The reservoir has a total infrastructural length of about 3.81 km for the dam wall and lined diversion canals. The reservoir is managed by a Water Users' Association (WUA) with about 150 registered members (Mdemu, 2008).

3.3.2 The Sumbrungu Scheme

The Sumbrungu Scheme is located approximately 4.5 km northwest of Bolgatanga. The community irrigation scheme was constructed in 1962 and rehabilitated between June 2002 and August 2003 under the Upper East Region Land Conservation and Smallholder Rehabilitation Project (LACOSREP) phase II Project. The reservoir, which is part of a cascading reservoir system is 10.6 ha in surface area

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(Liebe, 2002) and has a total area of 1.6 ha under cultivation. This reservoir is located near the main Bolgatanga-Navrongo road near the Bolgatanga Polytechnic.

3.3.3 The Winkogo Scheme

The Winkogo Community Irrigation Scheme was constructed in 1964 and rehabilitated in the early 1980s and in 1997 under the Upper Region Agriculture Development Programme (URADEP) and LACOSREP Phase I projects respectively (World Bank, 1987; IFAD, 2006). The management of the scheme was transferred to the village under the Water Users Association. The catchment area is about 142 ha.

3.4 Research Design

Research design normally contain among other things, the logical sequence in which the study is to be carried out as well as the its methods of data collection and analysis and all administrative procedures that need to be considered for the study to be carried out without problems or delays (Sarandakos, 1993). In other words, all the processes involved in planning and conducting the research from problem identification, data collection and analysis is part of the design.

Scientific inquiry as noted by Babbie (1992) could be exploratory, descriptive or explanatory. Exploratory research is carried out to examine new interest or when the field of study is relatively new or unfamiliar to the researcher. The objective of exploratory research is to identify key issues and key variables for further inquiry. Descriptive research seeks to provide an accurate description of observations of phenomena, while explanatory studies look for explanations of the nature of certain relationships, usually through testing hypothesis so as to provide an understanding of the relationships that exist between variables. This study adopted an evaluative and

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explanatory study design in order to determine the impact of the Small Scale Irrigation as an intervention that seeks to increase farmers output and contribution to poverty reduction.

The study used a semi-structured interviewer questionnaire to collect both quantitative and qualitative data that sought to elicit smallholder farmers' perceptions of the effects of the community irrigation schemes in improving their livelihoods at the time of data collection.

3.5 Study Population

The study population included all farmers who were registered members of the Water Users Association (WUA) and non-irrigation farmers in the three case study communities.

3.6 Sampling Procedure

It is often difficult if not impossible to study the whole population because of limited resources and time constraints (Statistics Canada, 2009). Therefore sampling is the selection of a subset of units from a target population for the purpose of collecting information that can be generalized over the entire population.

Irrigation farmers were considered as those who regularly engage in dry season farming using water from the community irrigation scheme, and non–irrigators as those who predominantly depend solely on rain-fed subsistence agriculture.

3.7 Sample Size Selection

The Dorongo, Sumbrungu and Winkogo schemes were purposively selected because of accessibility, scale, functionality, management type and similarity in terms of crops cultivated and of market access. The researcher had earlier obtained

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information from the Municipal Directorate of Food and Agriculture on the number of community-based irrigation schemes and the years of their existence, surface water resource potential for irrigation as well as the number of potential beneficiaries.

The schemes are all located in close proximity to Bolgatanga. This has significance for the people in these communities in terms of the disposal of their surplus products as well as opportunities for other livelihood pathways. All the schemes use the gravity system of irrigation.

The sample frame for irrigation the farmers consisted of 289 farmers who had registered to undertake dry season farming during the 2012/2013 cropping season in the three communities (See Table 1). The sampling frame for rain-fed farmers was not available. The list of registered irrigators was obtained from the Secretaries of the community Water User Associations (WUAs). The total of 289 WUA members under the three schemes is made up of 150 farmers in Dorongo, 41 farmers in Sumbrungu and 98 farmers in Winkogo. The researcher decided on a convenient sample of 240 farmers (120 irrigators and 120 non-irrigators) for data collection due to resource constraints. The irrigators sample for each community was chosen with a probability proportionate to its sample frame size, and then an equal number of farmers who have never participated in irrigation farming selected from each community (see Table 3.1).

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3.8 Sample Size Determination

Following the sampling process explained above, a total sample size of 240 respondents comprising 120 irrigation users and 120 non-irrigation users was conveniently determined to participate in the study as earlier indicated. With a total

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sample size of 240, and an unknown sample frame, the sample size calculator developed by US-based Creative Research Systems (CRS)[1] was used to calculate the Confidence Interval (CI) of ±6 at a Confidence Level of 95% (see Table 3.1).

Table 3.1: Sample Size of Respondents

Irrigation Scheme	Registered irrigation farmers (2012/2013 season)	Sample		
		Irrigation farmers	Rain-fed farmers	Total
Dorongo	150	62	62	**124**
Sumbrungu	41	17	17	**34**
Winkogo	98	41	41	**82**
Total	**289**	**120**	**120**	**240**

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3.9 Sources of Data

The study made use of both primary and secondary data. Primary data were gathered from the respondents of the study through interviews and observations. Secondary data sources on the other hand included books, peer-review journal articles, project documents, internet sites and periodicals. Such materials were extensively reviewed and relevant portions extracted and used in shaping the entire study. The secondary data also helped to put the study into perspective as well as provided the necessary theoretical tools within which the discussions in the study have been framed.

3.10 Data Collection Instruments

A semi-structured interviewer questionnaire, containing both opened and close-ended questions, was the main data collection instrument used. The questionnaire included topics on the demographic characteristics of respondents, their household characteristics, income/consumption patterns, household food security, employment

[1] Available at: http://www.surveysystem.com/sscalc.htm

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and the effects of small scale irrigation (Appendix1). Individual farmers were visited and interviewed to obtain information on how the irrigation project has influenced their poverty situation.

According to Mack et al. (2005) an interview is a technique designed to elicit a vivid picture of the participant's perspective on the research topic. Similarly, Patton (2002) observed that the interview is used to capture the complexities of the individual perceptions and experiences of those interviewed. The choice for interviews for the study was necessary because of its effectiveness of securing detailed information about the farmers' experiences of irrigation farming in relation to poverty reduction.

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3.11 Pre-testing of Questionnaire

The research questionnaire was pre-tested among 10 farmers in Sokabisi community near Dorongo. This community was selected because of its proximity to the study area and the fact that some farmers in the area also undertake irrigation farming in Dorungo. The pre-testing was to ensure that the questions were clear, appropriate and easily understood by respondents. It therefore helped in the redesign of the instrument. The actual data was collected in April/May 2013 by the researcher and six research assistants.

3.12 Data Processing and Analysis

Data collected from the household survey was entered in SPSS (Version 16) after which it was cleaned. The data was also analysed using SPSS. Generally analysis was based on the research questions. Qualitative data was manually organized into meaningful themes based on the topical issues addressed in the

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research. Quantitative data analyses were carried out using simple and relevant descriptive and inferential statistical methods such as means, percentages and frequency distributions and chi-square.

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CHAPTER FOUR
RESPONDENTS CHACTERISTICS AND POVERTY PERCEPTIONS

4.1 Introduction

This chapter first provides a description of the socio-demographic characteristics of study participants, the characteristics of irrigation farmers, landholding under irrigation, cropping pattern under irrigation and alternative livelihood strategies of respondents. Information on the length of time the participants had lived in the community and how long they have been involved in irrigation farming was also elicited. Then the general perceptions of respondents regarding the concept of poverty is presented and discussed.

4.2 Respondents Socio-Demographic Characteristics

The study unit of analysis was the farmer and therefore interviews were held with both female and male farmers who were either in dry season irrigation or rain-fed farming in the three study communities and who had lived in the community for not less than five years. Table 4.1 presents descriptive statistics of selected socio-demographic characteristics of respondents; sex, age, marital status, educational attainment and how long they had lived in the community. Out of the total sampled size of 235 farmers, 72 % were males. Seventy-two percent (72%) of respondents did not have any formal education, indicating that the educational level of respondents was low, with almost all of them (96%) living in their communities for more than 10 years.

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Table 4.1: Socio-demographic Characteristics of Respondents

Characteristic	Irrigators		Non-irrigators		Total	
	Freq	%	Freq	%	Freq	%
Respondent sex						
Male	78	65	90	78.3	168	71.5
Female	42	35	25	21.7	67	28.5
Total	120	100	115	100	235	100
Respondent age						
Less than 20 years	3	2.5	0	0	3	1.2
20-35 years	29	24.2	29	25.2	58	25.0
36-51 years	58	48.3	74	64.3	132	56.1
52 years and above	30	25	12	10.4	42	17.8
Total	120	100	115		235	100
Marital status						
Not married	9	7.5	5	4.3	14	6.0
Married/living together	95	79.2	93	80.9	188	80.0
Widowed/divorced	16	13.4	17	14.8	33	14.0
Total	120	100	115	100	235	100
Respondent educational level						
Illiterate	83	69.2	82	71.3	165	70.2
MSLC/JHS	25	20.8	26	22.6	51	21.7
SHS/Vocational	8	6.7	2	1.7	10	4.3
Post-sec and above	4	3.3	5	4.3	9	3.8
Total	120		115	100	235	100
Household Size	7.14		6.64			

Source: Field Work (2013)

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Fifty-six percent (56%) of respondents were within the age range of 36-51 years. Also, almost all respondents (94%) were either married or living with a partner, and majority (88%) were traditional worshipers.

The results revealed a rather disturbing situation of high illiteracy among irrigated and non-irrigated farmers in the study area. The study revealed that 69% of irrigators and 71% of rain-fed farmers were illiterate, while 21% of irrigators and 23% of non-irrigators had received basic education, with only 8 % of all farmer groups attaining formal education up to secondary school and beyond. Out of the 21% who had received basic education, 16 were males whiles 9 were females (data not shown). Several studies suggest that the level of education (years of schooling) of farm household members helps in the efficient use of production information (Lockheed et al., 1980; Wang et al., 1996; Weir, 1999; Asadullah & Rahman, 2005; Park & Lohr, 2005). Weir (1999:47) in a study on the effects of education on farmer productivity in rural Ethiopia, reported higher returns for farm household heads who had attained at least upper primary schooling (grades four to six). In addition, access to secondary education may provide skills which are useful for the allocation of inputs in a rapidly changing agro-technological environment, and enhance farmer ability to access and manage credit, particularly under irrigation.

The average household size was about seven persons, which is higher than the average household size of 5.5 for the then Talensi/Nabdam District and 4.9 for Bolgatanga Municipality as reported in the 2010 Population and Housing Census (GSS, 2012). Nearly all households make living out of subsistence agriculture and animal rearing. The average household size is relatively high.

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The importance of household size in rural agricultural production is central to the availability of farm labour, the quantity of farm produce used for home consumption, the surplus that could be sold for income, and household food security for that matter. Even under small scale irrigation in the study area, the major source of farm labour is provided by family members free of charge. The implication of this finding is that the quantity of food intake will be affected if the age dependency ratio (the ratio of dependents - people younger than 15 or older than 64 to the working age population - those ages 15-64) is high. In this case, the larger the family size the lesser food availability to each person within the household and also nutritional status would be affected.

4.3 Characteristics of Irrigation Farmers

A number of questions were used to assess the characteristics of dry season irrigation participants. Irrigators were asked to indicate whether they were members of the Water Users Association (WUA) established to manage the community irrigation scheme, the number of years in irrigation farming, the purpose for engaging in irrigation farming and the main crops grown under irrigation. Almost all (97%) of irrigators interviewed in the three study communities reported being members of the WUA. The WUAs were established under the IFAD funded Upper East Region Land Conservation and Smallholder rehabilitation Project (LOCOSREP II) to manage the community-based small scale irrigation schemes. The WUA Executives are responsible for collecting water user levies from the irrigators for minor repairs and maintenance of the canals. They are also expected to mobilise the members to provide communal labour for cleaning the canals, planting grass along the catchment

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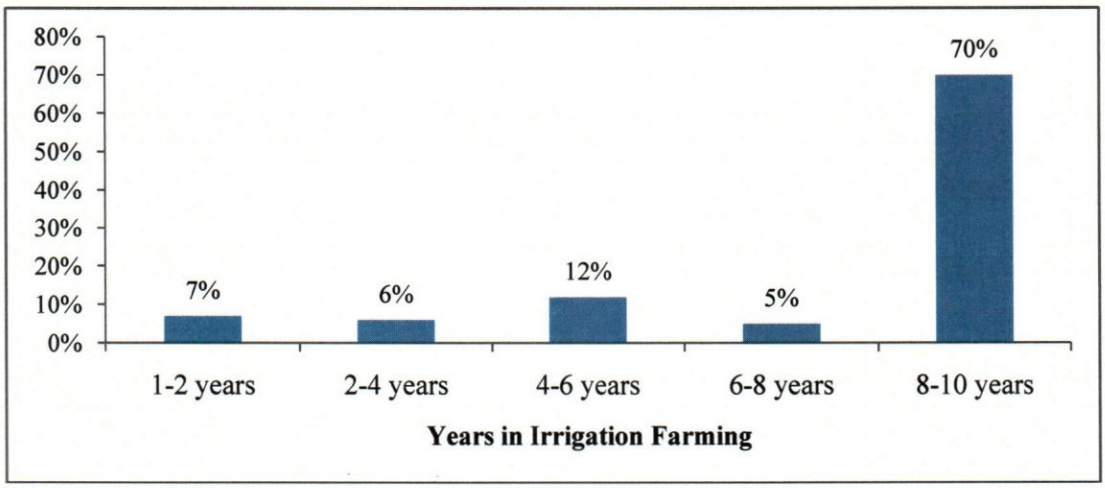
area and protecting the dam from erosion. However, it appears the inability of the WUAs to raise enough financial resources from members is a major weakness that threatens the sustainability of the schemes.

Farming experience is also an important factor that determines both the productivity and the production level in farming. But the effect of farming experience on productivity and production may be positive or negative. Although 70% of respondents reported having been in irrigation farming for more than eight (8) years in a descriptive analysis, experiences of household heads in irrigation in the three study area varied widely, with a minimum of only 1 year and a maximum of 5 years with a standard deviation of 1.267.

Figure 4.1: Experience in Irrigation Farming



Source: Fieldwork (2013).

Table 4.2 presents a multiple response analysis of factors that motivate respondents to engage in dry season irrigation. Majority of irrigators (57%) indicated that they engage in irrigation farming to supplement their household food requirements, while almost a third (28%) indicated that through irrigation farming

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they could support their children's education. The results is an indication that the schemes are perceived as avenues through which rural farmers could produce cash crops such as tomatoes, pepper, onions and leafy vegetables not only for sale, but also for home consumption. Cash earned during the dry season could also be used to buy foodstuff to supplement shortfalls in rainy season cereal production. From the findings, it could be said that access to irrigation could lead to some measurable impact on the socio-economic life of the beneficiaries as evidenced by the motivations for irrigation farming cited by the respondents.

Table 4.2: Reasons for Practising Dry Season Irrigation Farming

Characteristic	N =120	%
Irrigation for supplement food needs	68	57
Irrigation for financial independence	18	15
Irrigation for children education	34	28

Source: Field work (2013)

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4.4 Landholding Under Irrigation

Agricultural land and livestock are critical productive assets in the study area. As noted by Conway (2011), small landholders generally with few productive resources are unlikely to produce a surplus for sale, and in many cases small landholding do not guarantee full employment for farmer households. As illustrated in Table 4.3, the landholding of farmers undertaking irrigation in all the communities was relatively small, with a little more than half (51.2%) of irrigators in Winkogo cultivating less than 0.5 acres (0.2 ha). Generally, it has been found that agricultural landholding under rain-fed agriculture in the study and the Upper East Region as a whole is also

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small. For instance, an evaluation report of the Upper East Region Land Conservation and Smallholder Rehabilitation Project (LACOSREP II) estimated that in 1986 two-thirds of farmers in the region who had less than 4 acres (1.6 ha) were living in poverty (IFAD, 2006).

One reason for small land holdings under the various community irrigation schemes is the small size of irrigable lands in comparison with the number of farmers applying for dry season farming.

Table 4.3: Landholdings under Irrigation

	Community							
	Dorongo		Sumbrungu		Winkogo		Total	
Characteristic	N	%	N	%	N	%	N	%
< 0.5 acre	24	38.7	2	11.8	21	51.2	47	39.2
0.5-1 acre	24	38.7	9	52.9	19	46.3	52	43.3
> 1 acre	14	22.6	6	35.3	1	2.4	21	17.5
Total	62	100	17	100	41	100	120	100

Source: Fieldwork (2013)

The potential irrigable land under the Dorongo scheme is 112 ha, while that of Sumbrungu is 50 ha and Winkongo is 142 ha. In addition, the land under cultivation in each of the communities is usually determined by the level of water in the reservoir at the beginning of the dry season. As the farmers explained, the community dams have multiple uses including animal watering and for building purposes.

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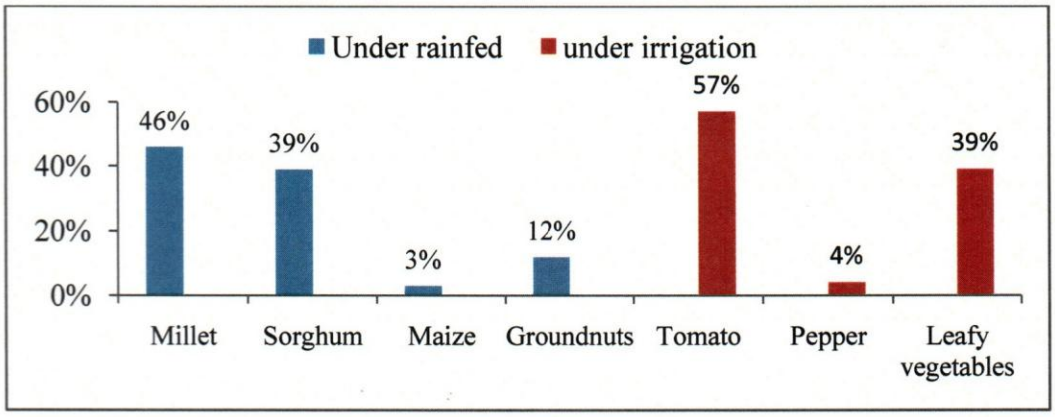
4.5 Major Crops under Rain-Fed and Irrigation Conditions

Typical staple crops grown under rain-fed in the study area by both irrigators and non-irrigators as shown in figure 4.2 are millet (46%), guinea Corn/sorghum (39%), maize (3%) and groundnuts (12%). However, it is not unusual for farmers to cultivate maize, sweet potato, rice, pepper, soya beans, Bambara beans and leafy vegetables alongside the major crops for household use.

Dry season irrigators cultivate vegetables, particularly tomatoes (56%), leafy vegetables (39%) and pepper (4%), mainly for cash to supplement household needs. For the majority of irrigators who cultivated tomatoes, 96% cited better price for choice of crop, 58% for good yield and only 15% reported selecting tomato for its high disease tolerance.

Figure 4.2: Main crops cultivated by farmers (Irrigators and Non-irrigators)



Source: Field work (2013)

Among the vegetable crops grown under the community irrigation schemes, tomato appears to have better market than pepper and the leafy vegetables. While tomato is sold to buyers from Accra, the leafy vegetables are mostly sold in the local markets. Irrigators who harvest their tomato early are most likely to get good prices

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as compared to those who harvest during the glut period. However during the field work, irrigators complained that their tomato production was adversely affected by a parasitic disease called "nematode", and this has been confirmed by Osei et al (2012) in their study.

4.6 Alternative Livelihood Activities

Though subsistence agriculture is the main occupation of the respondents, some engage in other livelihood activities such as petty trading (24%), handicraft weaving (14%), and artisanal trades (6%) as supplementary sources of income (Table 4.4). Remittances also cover 7.5% and 4.3% of the total income of the irrigators and rain-fed of farmers respectively. It appears income received from non-farm and off-farm activities helped some farm households to finance their dry season irrigation activities.

However, 42% of irrigators and 41% of rain-fed farmers reported they do not have any other alternative source of livelihood apart from farming. This should be a source of concern in that a huge portion of the rural farmers may not have other sources of livelihood apart from agriculture, which is largely rain-fed with the attendant problems. For the most part of the long dry season, farmers without access to irrigation will be unemployed and idle. This partly explains the high rate of youth out-migration from the study area to urban southern Ghana for employment. This situation further perpetuates existing inequalities and consequently poverty in the area. Majority (90%) of the irrigation farmers reported that the purpose of their involvement in irrigation farming was to produce for both for home consumption and for cash from sale of farm produce.

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Table 4.4: Alternative (off season) Sources of Income

Characteristic	Irrigators		Non-Irrigators		Total	
	Freq	%	Freq	%	Freq	%
Artisan	2	1.6	13	11.3	15	6.5
Trading/business	42	35	14	12.1	56	23.8
handicraft	13	10.8	23	20	36	15.3
Labourer (const)	11	9.2	16	13.9	27	11.5
Public servant	2	1.7	2	1.8	4	1.7
None	50	41.7	47	40.9	97	41.2
Total	**120**	**100**	**115**	**100**	**235**	**100**

Source: Field work (2013)

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4.7 Farmers Understanding of Poverty

The main focus of the study was to assess the extent to which small scale irrigation contributes to poverty reduction in surveyed communities. Hence, it was necessary to find out farmers perceptions of the attributes of poverty as well as its causes. An understanding of poverty from the farmers' own perspective helps in making a fair assessment of the contribution of small scale irrigation to poverty reduction.

In a multiple response analysis as shown in Table 4.5, almost all (98%) of irrigators and 97% of rain-fed farmers thought that poverty is all about the lack of food. Again, majority (82%) of irrigators and 83% of rain-fed farmers saw poverty to be lack of or insufficient income to meet basic needs. For this group of respondents, lack of money was the critical issue in that without money they cannot improve on their farming activities through crop diversification and the adoption of improved

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technologies. However, some of the respondents argued that the lack of money does not mean that one is poor. They explained that if one has enough food to feed the household and possibly help others, then that person cannot be labelled as poor. A small proportion (34%) of farmers viewed poverty as the lack of respect. Perhaps, it could be explained that the status of individuals in the study communities is not really determined by only their economic status (wealth). Other factors such as an individual's rank in the family, clan and community political or social structures play a more important role determining the level of respect or status of community members. Despite this, it is acknowledged that the very poor were likely to be treated with indignity in society.

An attempt was made through asking open ended questions to identify the major characteristics of the poor in the study area. Majority of respondents were quick to point out that poverty manifest itself through various ways. They indicated that the poor were those who are unable to meet their basic needs such as food, health, shelter and clothing. The poor are also often either under-employed or unemployed resulting in low incomes and subsequent dependence on others. Lack of self worth also came out strongly as a characteristic of the poor in the study area. The farmers understanding of poverty is in line with the basic needs theory postulated by Adelman (1974). This finding suggests that the concept of poverty is a complex phenomenon that can be seen and interpreted differently.

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Table 4.5: Distribution of Respondents Definitions of Poverty

Characteristic	Irrigation Farmers		Rain-fed Farmers	
	N	%	N	%
No money or income	98	82	95	83
No respect and dignity	54	45	40	35
Limited choices	85	71	81	70
No food	117	98	111	97

Source: Field work (2013)

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4.8 Perceptions on Causes of Poverty

A satisfactory explanation of the causes of poverty among farmers in the study area is essential if one is to recommend an effective strategy for poverty reduction. Since there is no reason to believe that the root causes of poverty are the same everywhere, specific analysis is essential. Through an open ended question, farmers were asked to identify the causes of poverty. Majority of the farmers mentioned poor climatic conditions such as erratic and unreliable rainfall resulting in frequent drought, pest and disease infestation, lack of farm inputs and credit, and poor health as the major causes of poverty. The causes of poverty identified by the respondents appear to fall under Ryan's (1976) classification of poverty into economic, political, and social distortion factors. Some farmers also mentioned poor access to employment and lack of natural resources as major causes of poverty, thus confirming Morrill &Wohlenberg (1971) findings. Surprisingly, a few respondents mentioned laziness as a major cause of poverty.

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CHAPTER FIVE
IRRIGATION AND POVERTY REDUCTION

5.1 Introduction

This chapter will present and discuss the results related to irrigation and poverty reduction linkages, focusing on those indirect impacts of access to year-round agricultural water that are often difficult to measure in economic terms. The chapter also presents and discusses the productive and non-productive assets that irrigation beneficiaries have acquired from dry season irrigation activities and the impact of irrigation on migration and community socio-economic live. These activities all have the potential to contribute towards reducing rural poverty and improving basic livelihoods.

5.2 Indirect Impacts of Irrigated Agriculture on Rural poverty reduction

It has been documented that there are several indirect or secondary pathways to poverty reduction or improved livelihoods resulting from the rural poor having access to irrigated agriculture for year-round crop production, even though these are rarely measured in economic impact analysis (Bhattarai, Sakthivadivel & Hussain, 2002). With this mind, the study assessed the indirect economic benefits of access to irrigation water for dry season farming that have poverty reduction potentials.The study participants were asked to indicate whether they agree or disagree with the following statements: a) irrigation farming provided employment during the dry season, b) irrigation farming helped farmers to improve their housing conditions, c) irrigation helped to improve the nutritional status (diet) of family members, d) income from irrigation helps farm households to access health care, e) income from irrigation helps farmers to pay children's school fees, and f) income from irrigation

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helps farmers to acquire household assets (bicycles, motors, TVs, donkey carts, Motor King, etc).

As shown in figure 5.1, almost all (more than 90%) of the farmers surveyed had either agreed or strongly agreed that access to dry season irrigation in their communities has provided them with employment year round, helped them to improve their housing conditions, improved household nutrition, improved access to health care and enabled them pay their children school fees. In addition, more than two-thirds (67%) of respondents reported having acquired household assets through irrigation farming. Among farmers that are 52 years or older, 70% agree or strongly agree with the statement that irrigation has enable them to acquire livestock such as cattle, goats, sheep and pigs. In contrast, 82% of farmers younger than 51 years agree or strongly agree with the statement. These results suggest that farmers are generally satisfied with the benefits and positive impacts of dry season irrigation on their livelihoods.

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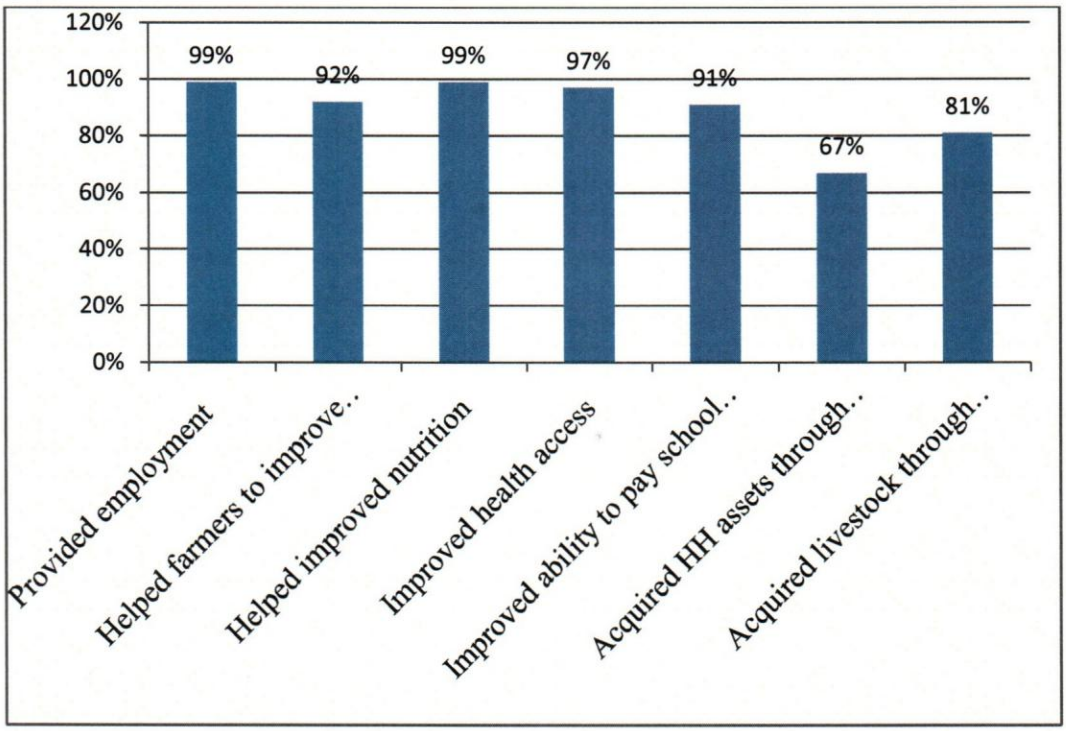
Figure 5.1: Responses on statements on impact of Irrigation on Poverty



Source: Field data (2013)

5.3 Assets Acquisition from Irrigation Farming

The asset base of individuals and households for that matter is often used as an indicator to measure the level of poverty. This is because some assets, particularly productive assets, play a crucial role with regard to the productive capacity of individuals and households and also serve as safety nets during periods of food insecurity. Thus, the study assessed the impacts of the community-based irrigation schemes on asset acquisition. Survey respondents' who reported having bought assets from their irrigation activities were further asked to indicate the specific assets acquired. The study revealed that irrigation farmers had acquired productive assets and non-productive assets, such as bicycles (n = 72%), livestock (n = 75%), and motorbike that increased their productive capacities and reduced travelling time to

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nearest communities —factors that would likely continue to increase their incomes and thus reduce poverty (see Table 5.1).

Table 5.1: Assets Bought from Irrigation Farming

Assets acquired from irrigation farming	Community						Total (N =120)	
	Dorungo (N = 62)		Sumbrungu (N = 17)		Winkogo (N = 41)			
Yes response	N	%	N	%	N	%	N	%
Roofing sheets	29	47	14	82	15	37	58	48
Household assets	50	81	12	71	24	59	86	72
Bicycle	33	53	16	94	26	63	75	63
Motorbike	8	13	5	29	9	22	22	18
Household furniture	23	37	10	59	17	41	50	42
Livestock	46	74	16	94	28	68	90	75

Source: Field data, 2013

The acquisition of assets is an indication that access to irrigation is crucial for socio-economic empowerment and poverty reduction. Acquiring building materials such as roofing sheets enable rural households to improve their housing conditions. The livestock in the form of cattle (bullocks), donkeys, sheep and pigs are used for draught power and can be sold, especially during stress, for income to buy basic needs. In addition, livestock are a form of investment and are usually used for dowry payment and for performing funerals, among other socio-cultural purposes.

5.4 Impact of Irrigation on Migration

The lack of employment opportunities, especially during the long dry season, has been cited as a major contributory factor for high levels of labour migration in the Upper East Region and the study communities for that matter (IFAD, 2006). Therefore, access to irrigated agriculture year-round through the community-based

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small schemes was meant to reduce the need for younger people to look for work elsewhere and thus ensure the stability of households (IFAD, 2006).

Thus, farmers were asked to indicate whether they agree or disagree with the statements that; a) irrigation helped to reduce out-migration of the youth from their community, and b) community irrigation schemes have made significant impact on improving the wellbeing of individual farmers and households.

As shown in Figure 5.2, majority of respondents in all the study communities agreed or strongly agreed that dry season irrigation has helped in curbing the out-migration of the youth from their communities to elsewhere in search of employment. In terms of the impact of each of the irrigation schemes in reducing youth out migration, the results seem to suggest that the Dorongo scheme has made a greater impact (n =90%) compared to the other two community schemes.

In addition, majority of the respondents thought that the presence of the small irrigation schemes have made positive impacts on the socio-economic lives of the people. As one young man in Dorongo reported "through the small monies we earned from the dry season farming, we are able to marry beautiful girls and dowry them. This finding suggests that community-based small scale irrigation facilities have enabled farmers to cultivate more than one rain-fed crop, and such multiple cropping possibilities contributed to reducing the incidence of migration.

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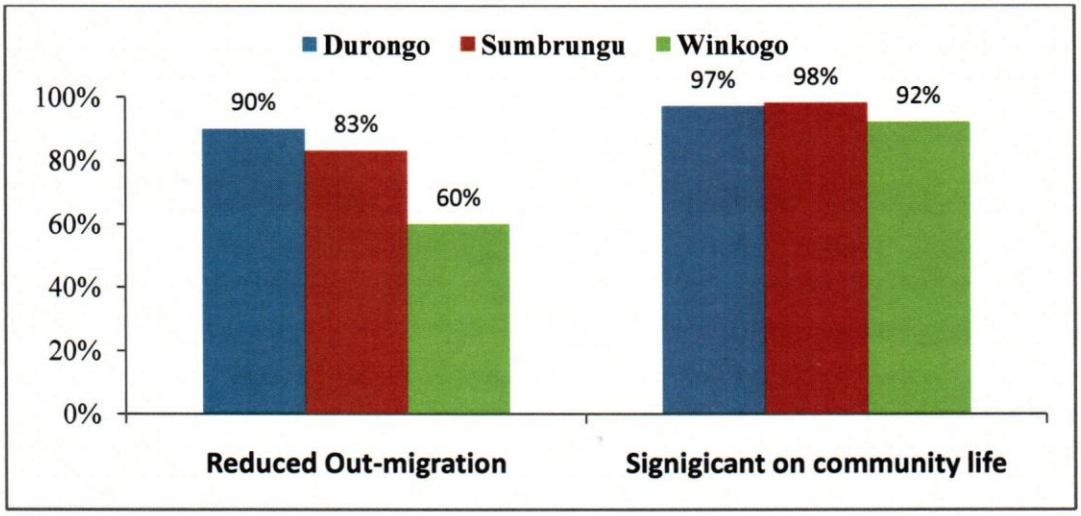
Figure 5.2: Responses on the Positive Impact on Irrigation on Migration



Source: Fieldwork (2013)

Similarly, Kpieta, Owusu-Sekyere and Bonye (2013) also found that youth out-migration from communities with small scale irrigation dams in Wa West District of the Upper West Region was very minimal as compared to non-dam communities.

It is encouraging that the results points to a positive impact of irrigation on reducing the incidence of out-migration of the youth as well as enhances the general well-being of people in the study area. Abject poverty combined with land shortage and population pressure has fueled out-migration of the youth in the Upper East Region to the southern of Ghana to look for employment (IFAD, 2006). Triggered by poverty and lack of jobs, labour migration seems to be an effective and attractive strategy for getting out of the poverty trap through remittances from migrant family members, although it also creates family instability. While the income received from agricultural products is mainly used for daily expenses, the remittances from migrant labour are normally used for investments such as the construction of a house and children education.

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CHAPTER SIX

IRRIGATION AND HOUSEHOLD FOOD SECURITY

6.1 Introduction

The research investigated and compared the sources of household food, whether farmer households experienced food insecurity during the past 12 months, perceptions on the causes of food insecurity and the role of irrigation in reducing food insecurity in the three communities. This chapter presents and discusses the irrigation and food security inter-relationships.

6.2 Household Sources of Food

The study revealed that household food came from two main sources: own staple food production under rain-fed agriculture and food purchases from the market. As presented in Table 6.1, fewer irrigators in all the three communities were likely to depend on their own food production compared to non-irrigators. Eleven percent of irrigation beneficiaries compared with 36% of non-beneficiaries depended on their own food production in Dorongo, and in Winkogo 22% of irrigators compared with 37% of non-irrigation farmers reported own production as source of household food. The study revealed that majority of both irrigators and rain-fed farmers rely on the market as a secondary source of food. This indicates that household grain stocks are usually exhausted during the lean season in April-May. This finding further suggests that staple cereal crop production under rain-fed cultivation was inadequate for both irrigators and non-irrigators to ensure food availability throughout the year. Irrigators were more likely to use cash earned from

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irrigation farming to purchase food to supplement shortfalls in rain-fed food production.

Table 6.1: Sources of Household Food

Characteristic		Household Source of Food: Own farm	Household Source of Food: Own farm & purchase	Total
Dorungo	Irrigators	7 (11%)	52 (84%)	62
	Non-irrigators	22 (36%)	40 (65%)	62
Sumbrungu	Irrigators	8 (47%)	8 (47%)	17
	Non-irrigators	6 (50%)	6 (50%)	12
Winkogo	Irrigators	9 (22%)	32 (78%)	41
	Non-irrigators	15 (37%)	26 (63%)	41

Source: Fieldwork (2013)

6.3 Food Shortage in the Preceding Cropping Season

Months of inadequate household food provisioning has been defined as the time between stock depletion and the next harvest (Bilinsky & Swindale, 2007). It is usually used as a measure of food insecurity in a highly subsistence-oriented area where production is primarily for home consumption and households do not make significant sales or purchases in the market. Hence, respondents were first asked whether they had experience shortage of staple foods during the preceding harvest season. As presented in Figure 6.1, two-thirds (66%) of irrigators in all the three communities compared to majority (73%) of rain-fed farmers reported having experienced food shortages from harvest of the preceding rainy season cultivation.

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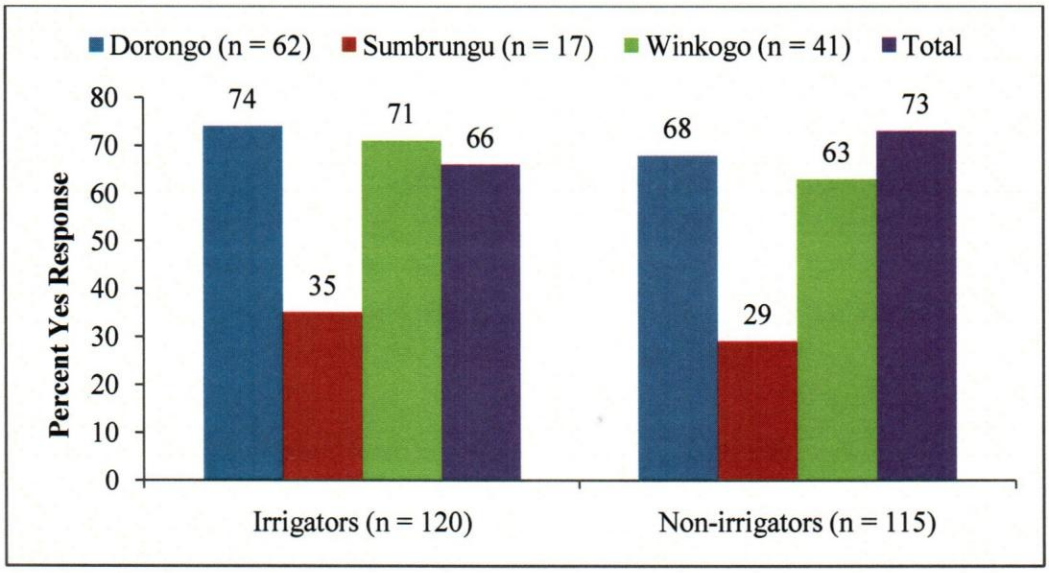
Figure 6.1: Percentage "Yes Response" on Food Shortages



Source: Fieldwork (2013)

This finding is consistent with the findings of the July 2012 Northern Ghana Food Security and Nutrition Monitoring System (FSNMS) that generally the food security situation in the Upper East Region is more pronounced than in the Northern and Upper West Regions. The FSNMS reported that 56% of respondents of sentinel sites in the region have 10% or less of their harvest remaining from the previous season, and 89% are relying on the market as a primary or secondary source of food (SRID/MoFA, 2012).

Survey respondents who reported experiencing food shortages were further asked to indicate the number of months they had experienced food shortage during the year. As illustrated in Figure 6.2, fewer irrigator households (5%) experienced shorter periods of food shortage of between 1 to 2 months compared to 19 % of rain-fed households. Interestingly, more irrigators (13%) as against 3% of rain-fed farmers

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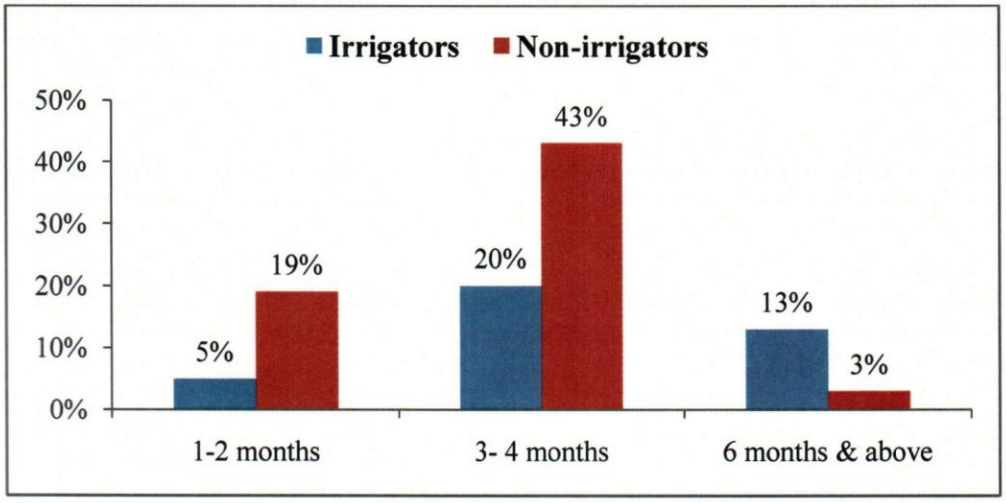
reported having experienced food shortage throughout the year. However, in cross tabulation, it became clear that out of the 13% irrigators who did not meet their food consumption needs throughout the year, 80% of the respondents were from Winkogo. This was not surprising because the Winkogo scheme appear to have been underutilized with most of the canals broken. The irrigable land area under cultivation is also very small and it appears only leafy vegetables are cultivated, mainly for home consumption.

Figure 6.2: Yes responses to months of food shortages.



Source: Field work (2013).

6.4 Perceptions on Causes of Household Food Insecurity

As presented in table 6.2, almost all respondents, 93% (n = 111) of irrigators and 91 (n = 88) of rain-fed farmers attributed declining (poor) crop yields as a major cause of food insecurity, followed by weather vagaries such as irregular rainfall pattern (83% or irrigators and 89% or non-irrigators respectively). Similarly, the FSNMS also reported that one third of respondents complained of irregular rainfall for

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food insecurity resulting from poor harvest (SRID/MoFA, 2012). Fewer respondents, 37% of irrigators and 34% of the rain-fed farmers, thought that the household size could be the cause of food insecurity. On the contrary, Aidoo, Mensah and Tuffour (2013) reported that household size had a negative and significant relationship with food security, suggesting the probability of food security decreasing with increasing rural farm household size. As noted earlier, the importance of household size in rural agriculture is central to the availability of farm labour and respondents may consider large family sizes as a productive resource that could be mobilised to increase household food security through labour provision on family farms.

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Table 6.2: Respondents Perceptions on the Causes of Food Insecurity

	Irrigators		Non-irrigators	
Characteristic	**N = 111**	**% of Cases**	**N = 88**	**% of Cases**
Household size	41	37	30	34
Cost of production inputs	40	36	48	55
Low income of farmers	53	48	56	64
Poor harvest	103	93	80	91
Weather vagaries	92	83	78	89

Source: Fieldwork (2013)

6.5 Coping Strategies

Coping strategies refer to measures households employed when food is insufficient. In other words, the adjustments in behaviour households adopt during periods of food insecurity (Maxwell & Caldwell, 2008). During periods of food shortage, households adopt a wide range of coping strategies to sustain their food

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availability. The study measured household food security by asking respondents whether in the previous month following the survey, 1) family members ate fewer meals per day than usual, 2) reduced food quantity per meal, 3) ate less preferred foods, and 4) some family members worked outside to earn money for food.

As presented in Table 6.3, respondent households employed a range of coping strategies in response to food shortages during the month (March) preceding the survey. Majority of both irrigators and non-irrigators surveyed reported that their family members ate fewer meals, reduced food quantity per meal, and ate less preferred meals in March preceding the survey. It is important to note that in March most households may not be chronically food insecure. The critical period during which households in the study area may not have food stocks at all from own produce is usually May–June. The findings suggest that the main coping mechanisms households were likely to adopt during food shocks include reduction of food intake and consumption of less preferred foods.

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Table 6.3: Percent Distribution of Household Coping Strategies

	Irrigators		Non-Irrigation	
Coping strategy	N = 88	% of Cases	N =84	% of Cases
Ate fewer meals per day	63	75	76	86
Reduced food quantity per meal	66	79	72	82
Ate less preferred food	71	85	75	85
Work outside to buy food	71	85	34	39
Sold livestock to buy food	69	78	57	68
Received food assistance	8	10	16	18

Source: Field work (2013)

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Similarly, the July 2012 Northern Ghana FSNMS sentinel survey also reported that households in the Upper East were more likely to rely heavily on coping strategies during the lean season, with 83% eating fewer meals - only two meals per day (SRID/MoFA, 2012). The high proportion of households already consuming fewer meals per day in March suggests high levels of vulnerability to food insecurity and the need for promoting irrigated agriculture in the study area instead of the over-dependence of unpredictable rain-fed agriculture

It is not surprising to find that the sale of livestock plays a crucial role in bridging the hunger gap. In mixed-farming systems, livestock rearing reduce the risks associated with crop production and therefore represent liquid assets that can be traded at any time, adding further stability to the household production system. This confirmed the reason why most of the respondents indicated that income from irrigation was partly used to invest in livestock keeping, which serve as safety nets during shocks.

6.6 Contribution of Irrigation to Food Security

Irrigators were asked to indicate whether irrigation farming contributed to reducing food insecurity in their communities. On the other hand, the rain-fed farmers were also asked whether they think lack of access to dry season irrigation aggravates food unavailability in their households. Majority (87%) of irrigators were of the view that access to irrigation for year all round farming contributes significantly to reducing food insecurity. On the other hand, 66% of rain-fed farmers thought reliance on rain-fed agriculture alone was not enough to ensure household food availability throughout the year (data not shown).

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In a study, Oxfam (2011) found that access to community irrigation in Malawi created new sources of food and income to peasant farmers by making water available all year round for crop diversification. Similarly, Saleth et al (2003) pointed out that access to irrigation has been regarded as a powerful factor that provides a greater opportunity for multiple cropping, cropping intensity and crop diversification. Small scale irrigation does not only improve food security but a better nutritional diet to irrigation farmers and entire communities (Burney et al., 2010; Aseyehegn, Yirga & Rajan, 2012). Vegetables produced under irrigation are rich in micronutrients and provide important benefits, especially on birth weight, child anthropometric status, and improved hemoglobin concentrations (Hoddinott & Yohannes, 2002; Namara et al., 2011).

Irrigation systems are also likely to improve the intake of animal-source foods as a result of higher incomes and improved livestock productivity as revealed from the study that income gains from livestock were 14 percent higher among irrigation users compared to non-users. Animal-source food is an important source of vitamin A, iron, riboflavin, calcium, zinc, and vitamin B12, which are all important for young children growth and development (Murphy & Allen, 2003).

Namara et al. (2011) compared the Household Dietary Diversity Score of farmers using rain-fed agriculture with that of farmers using groundwater irrigation in Ghana and reported that as a result of enhanced access to fresh vegetables and animal sources of food, irrigation systems can improve nutrition and health, particularly of children. Consumption of iron-rich foods, such as dark green leafy vegetables, can reduce incidences of anaemia. Iron deficiency is a risk factor for maternal mortality

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and is responsible for 115,000 deaths (Black et al., 2008). Furthermore, access to greater quantities of nutritious food can reduce incidences of underweight and wasting.

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CHAPTER SEVEN

IRRIGATION AND HOUSEHOLD INCOME

7.1 Introduction

This chapter presents the results and discussion on the role of irrigated agriculture on increasing farm households' incomes, which is a direct route to poverty reduction. The results on sources of respondents' incomes are first presented and discussed, followed by the expenditure distribution of earnings from irrigated agriculture, and the proportion of farmers' income that comes from irrigation farming. Then the results of challenges faced by farmers is presented and discussed.

7.2 Sources of Farm Household Income

A very important poverty indicator in Ghana and globally is income levels. Thus the study attempted to elicit information on the main sources of income of both irrigators and non-irrigators. As shown in figure 7.1, the main sources of income for irrigation farmers was more likely to come from the sale of farm produce (84%), most probably from dry season crops, as compared to (13%) of rain-fed farmers who reported earnings from the same source. For rain-fed farmers, the main source of income was likely to be off-farm employment such as petty trading, artisanal trades and handicrafts.

From the results, it appears dry season irrigation is a major source of income for some farmers in the study communities. Under irrigation, farmers could crop twice during the year, growing mostly food crops during the rainy season and cash crops under irrigation. This may explain why irrigators considered the selling of farm produce as their main source of income.

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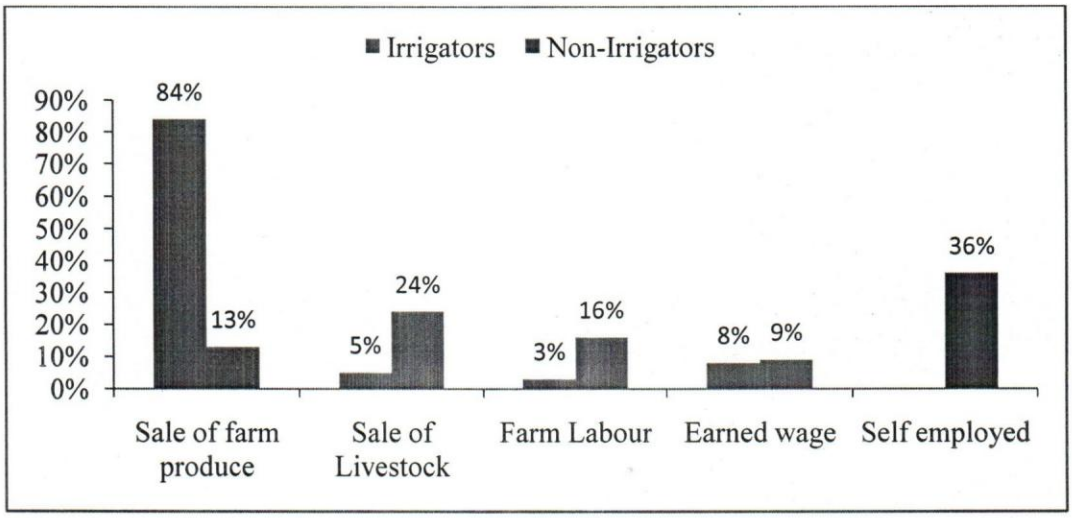
Figure 7.1: Sources of Farm Household Income



Source: Field work (2013)

Forty-three percent of irrigators reported that they farm to feed themselves, and 55% indicating that their farm produce are used for both household consumption and for cash (data not shown). In the study area, food crop production during the rainy season is mostly meant for household consumption, although farmers may sell some to meet basic household needs. For most smallholder households the sale of livestock, particularly small ruminants and poultry, is another source of income. Livestock are also kept as a form of investment and/or for socio-cultural purposes such as funeral performances, payment of dowry, sacrifices and festivals. It appears that non-irrigators were more likely to engage in some form of self employment such petty trading, handicraft weaving and artisanal trades during the off farm season.

7.3 Household Expenditure from Irrigated Income

The farmers were asked to indicate how they use income earned from irrigation farming. In a multiple response analysis as shown in Table 7.1, almost all (94%, N = 112) of the irrigators reported that income earned was used to purchase food to

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supplement their rainy season staple crop production, followed by the payment of school fees (84%, N = 100) and health care expenses (76%, N= 90). This finding clearly shows that food security based on farm households' own production appears unattainable, even though irrigation farmers can achieved economic food security by buying food from income earned from vegetable cultivation under small scale irrigation.

Table 7.1: Respondents Irrigation Income Expenditure Pattern

	Community							
	Dorungo (n = 61)		Sumbrungu (n = 17)		Winkogo (n.=.41)		Total (N = 119)	
Characteristic	N	%	N	%	N	%	N	%
Farm inputs	33	54	12	71	22	54	67	56
Food	59	97	15	88	38	93	112	94
Health care	43	71	14	82	33	81	90	76
School fees	53	87	16	94	31	76	100	84
Investment	23	38	9	53	1	2	33	28
Purchase livestock	30	49	16	94	18	44	64	54

Source: Fieldwork (2013)

It is also important to note that nowhere is the lack of economic opportunities greater in Ghana than in the study area, where farm sizes are very small and highly fragmented. Agricultural land is severely degraded and poor health and education limit productivity and access to better options. Population pressure, alongside declining landholding and erratic rainfall, is also major obstacle to socio-economic development.

It is, therefore, encouraging that the irrigation beneficiaries invest their incomes in food and nutrition, education and health care. As the World Bank (2007) pointed out, investments in health and education are critical pathways of enhancing human capital for poverty reduction. The World Bank (2007:9) notes that, "education is

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often the most valuable asset for rural people to pursue opportunities -obtain skilled jobs, start businesses in the rural nonfarm economy, and migrate successfully. Awan, Malik, Sarwar & Waqas (2011) also concluded that in the long-term, investment in education is the most important factor regarding poverty reduction. Income from irrigation that is used to educate the children of rural farmers enhances the future earning potential of household members, and consequently the increased earnings will help them to get out of poverty.

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7.4 Assessment of Household Mean Income

The study collected self-reported data on income levels of all respondents. The income, which was derived from on-farm and off-farm activities, was categorised as earnings from irrigation crop sales, from rain-fed crop sales, livestock sales, and from off-farm activities such as petty trading, wage labour, artisanal services, natural resources extraction and remittances.

As presented in Table 7.2, the total self-reported income of irrigation farmers was GH¢14,575.46 as compared to GH¢ 4,599.59 for rain-fed farmers. Out of the total income of the irrigators, GH¢12,934.98 representing 89% of their earnings came from the sale of irrigated crops. This suggests that irrigation enhances the income of farmers compared to those who don't have access to agricultural water throughout the year, implying that access to irrigation directly reduces the poverty level of beneficiaries through increased household incomes. Further analysis as shown in (figure 7.2) revealed that income from tomato production contributed the highest to total crop income during the 2011/2012 dry season farming with 80.5% followed by leafy vegetables (12.3).

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As Lipton and Litchfield (2003) argued, irrigation boosts total farm output and hence, with unchanged prices, raises farm incomes. In this context, during periods of good yields and stable prices, irrigators are more likely to have additional sources of income than non-irrigators. Similarly income from livestock was also higher (524.55) than non irrigation Users with mean income of 408.73 from livestock. Livestock serve as a source of income and during periods of crop failures household that own livestock compensates failed crops through sale of their livestock to meet the household food needs.

Table 7.2: Respondents Self-reported Incomes

Income Source	Irrigators (N = 119)	Non-Irrigators (N = 107)	T value
Crop sales (irrigated)	12,934.98	-	10,169***
Crop sales (rain-fed)	5,225.32	7,084.61	2.878***
Livestock sales	1,864.46	1,010.46	3,026***
Total on-farm income	**20,024.76**	**8,091.07**	**7.497*** **
Less total farm expenses	6,695.76	2,184.64	7.273***
Net on-farm income	**12,329.00**	**5,878.73**	**6.065**
Add total off-farm Income	246.46	689.16	0.488
Total Annual Income	**GH¢14,575.46**	**GH¢4,599.59**	

Source: Field work (2013)

One interesting result of the assessment of household income from the sale irrigated crops was that, most of the respondents indicated that income was given to a household member to start up a business while others reported having invested their

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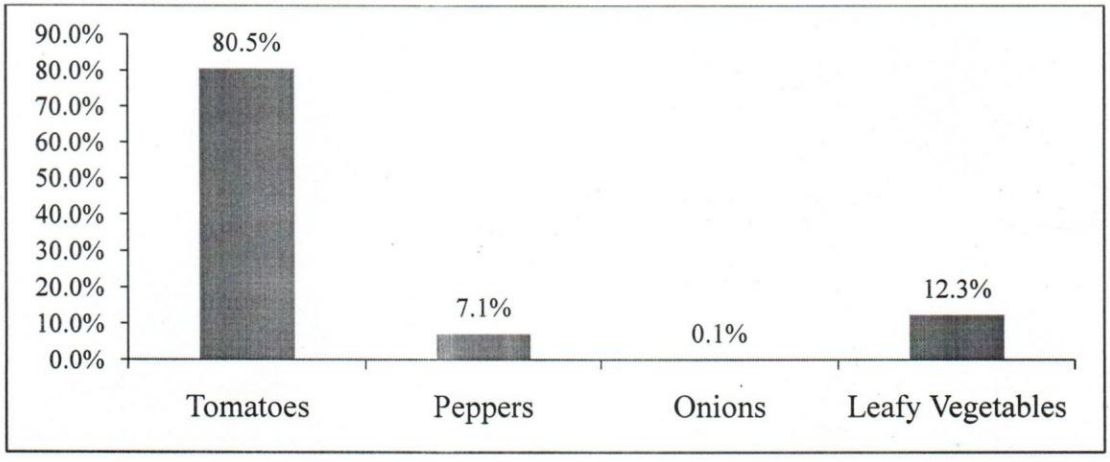
income in transport (motor king) business and gold mining. This seems to suggest why the mean income from off farm activities is quite high.

It is not surprising that rain-fed farmers reported negligible incomes from the sale of farm produce. As Snyder et al (2013) pointed out, rain-fed agriculture is the primary livelihood strategy of the majority of the people in the study communities, and people farm first to meet household food requirements, and then sell any remainder to meet basic needs. This partly explains the low household incomes from on-farm sources. The low earnings from sale of agricultural products are compounded by the few opportunities for off-farm employment available to the people.

It was not also a surprise that all irrigators in Sumbrungu (N =17) and Winkogo (N= 41), and almost all (95%, N = 62) of those in Dorongo reported that they will continue with irrigation farming, since it enhances their incomes, food security and year-round employment (data not shown).

Figure 7.2: Percentage of income from irrigation farming



Source: Field work (2013)

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7.5 Challenges of Small-scale Irrigation Farmers

The earlier analysis points to the fact that small scale irrigation farming has immeasurable potentials to improve the incomes and thus the poverty situation of rural farmers, but it is never free from some constraints. Therefore, the survey asked respondents (irrigators and non-irrigators) to identify the major constraints to their farming operations, especially irrigated agriculture, vis-à-vis their attempts to increase crop production. The results of the assessment of the sample farmers are presented in Table 7.3.

The constraints identified included inadequate access to extension services, poor market prices, poor maintenance culture of the schemes, disease infestation, high input cost, inadequate credit, and unavailability of ready market for farmers. The majority of respondents (60% of irrigators and 97% of rain-fed farmers) indicated that they had problems accessing extension services. Again, almost all the farmers interviewed (more than 90%) reported difficulty in securing credit to buy inputs such as seeds, fertilizer and agro-chemicals. There is therefore the likelihood that yields obtained per land size under cultivation would fall below the expected yields.

In addition, almost all (98%) of irrigators and majority (81%) of them reported high disease infestation of irrigated crops, especially nematodes, and poor maintenance of the schemes, as constraints to dry season farming under irrigation.

The marketing system available to farmers appears not to facilitate desirable expectations. Majority (81%) of irrigators reported the lack of good and readily available market as a challenge that needs to be addressed. Irrigators complained that there are no organized markets for their crops, especially tomato. This is consistent with Robinson and Kolavalli (2010) finding that prices were relatively low for

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irrigable crops like tomato in the Upper East Region during the peak season, whether farmers are selling in the local markets or to the traders from outside.

Table 7.3: Responses on Farming Constraints

	Irrigators		Non irrigators	
Characteristic	**N**	**%**	**N**	**%**
Inadequate access to extension services	72	60	112	97
Inadequate access to credit	112	93	112	97
Poor market price for farm produce	97	81	104	90
High water use levy	29	24	--	--
High cost of farm inputs	114	95	103	90
Lack of transport	59	49	49	43
Poor maintenance of irrigation facility	107	89	--	--
High prevalence of crop pest and disease	118	98	99	86
Erratic rainfall pattern	--	--	115	100

Source: Field work (2013)

A possible explanation for the poor marketing outcomes could be due to the type of crops cultivated by most farmers (tomato) under irrigation, the seasonality of harvest times, lack of storage and processing facilities and poor transport infrastructure. One key challenge which is related to lack of market raised by the irrigated respondents was the lack of processing facility. In an open ended question, almost all the respondents suggested that the government should revitalize the Pwalugu Tomato Factory.

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Closely related to the challenges of poor market access is the high cost of farm inputs. Farmers reported high cost of inputs such as fertilizer and other agro-chemicals like pesticides and herbicides. Most farmers reported finding it difficult to buy chemical fertilizers, and even in situations where they can afford a little, they are not able to buy enough quantities in the right mix for application as recommended. The implication is that crop performance is likely to be sub-optimal, resulting in low yields and poor quality harvest. Various studies in Ghana and elsewhere have underscored the importance of the availability and application of modern farm inputs such as chemical fertilizers, improved seeds, and other agro chemicals towards increasing crop yields and productivity in smallholder farming systems (Agbanyo, 2012; Liverpool-Tasie, Kuku & Ajibola, 2011; Degefa, 2006).

On observation, it appears poor water management and poor culture of maintenance over the years has resulted in cracks of the main canals and laterals of all the three schemes, leading to massive water leakages and wastage. Major activities like operation and maintenance of the systems require commitment, co-ordination and collective action on the part of the WUAs. The community schemes are supposed to be managed by the community through the collection of user fees.

Another significant factor that is likely to affect the performance of small scale irrigation is the lack of agricultural support services, including credit, extension and advisory services. A little less than half (43%) of irrigators and fewer rain-fed farmers (10%) reported having had access to credit to support their farming ventures during the 2012/13 farming season (data not shown).

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CHAPTER EIGHT

CONCLUSIONS AND RECOMMENDATIONS

8.1 Introduction

This chapter presents the summary of the study findings, conclusions and recommendations.

8.2 Summary of Study Findings

The main objective of the study was to examine the impact of improved agricultural water access and use of small-scale irrigation schemes on poverty reduction and food security of smallholder farm households in the study area from the perspectives of farmers. Specifically, the study sought to assess farmers' understanding of poverty and its causes; assess the secondary (indirect) impacts of the irrigation schemes to the socio-economic lives of farm households and poverty reduction for that matter; assess the impact of the irrigation schemes on improving household food security; assess the impact of the irrigation schemes on increasing household incomes; and assess the problems farmers encounter in irrigated agriculture.

A total of 235 farmers (120 dry season irrigation farmers and 115 rain-fed farmers took part in the study). Of the 120 irrigation farmers who participated in the survey, more than half (57%) indicated that they engaged in irrigation farming to supplement their household food requirements, while almost a third (28%) indicated that through irrigation they could support their children's education. However, landholding under irrigation in all the communities was relatively small, with a little

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more than half (51.2%) of irrigators in Winkogo cultivating less than 0.5 acres (0.2 ha). The main crops under irrigation are tomatoes and leafy vegetables.

Regarding farmers' understanding of poverty, almost all (98%) of irrigators and 97% of rain-fed farmers thought that poverty is all about the lack of food. Again, majority (82%) of irrigators and 83% of rain-fed farmers saw poverty to be lack of or insufficient income to meet basic needs. As a result, majority of study participants classified the poor as those who are unable to meet their basic needs such as food, health care, shelter and clothing. The poor were more likely to be under-employed or unemployed resulting in low incomes and subsequent dependence on others. On the causes of poverty in their communities, majority of the farmers mentioned poor climatic conditions such as erratic and unreliable rainfall resulting in frequent drought, pest and disease infestation, lack of farm inputs and credit, and poor health as the major causes of poverty.

Almost all (more than 90%) of irrigators had either agreed or strongly agreed that access to dry season irrigation in their communities provided them with employment year-round, helped them to improve their housing conditions, improved household nutrition, improved access to health care and enabled them pay their children school fees. In addition, more than two-thirds (67%) of respondents reported having acquired household assets through irrigation farming. The study revealed that irrigation farmers were more likely to acquire productive assets and non-productive assets, such as bicycles (n = 72%), livestock (n = 75%) compared to rain-fed farmers.

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Again, majority of respondents in all the study communities agreed or strongly agreed that dry season irrigation has helped in curbing the out-migration of the youth from their communities to elsewhere in search of employment.

The study found that most households in the study communities were food insecure for about four months during the long dry season. Hence, when asked whether irrigation farming contributed to reducing food insecurity in their communities, majority (87%) of irrigators reported that access to irrigation for year all round farming contributes significantly to reducing food insecurity, since they could buy staple foods from earnings from sale of irrigated crops.

The main sources of income for irrigation farmers was more likely to come from the sale of farm produce (84%), mostly from dry season irrigated crops, as compared to (13%) of rain-fed farmers who reported earnings from the same source. For rain-fed farmers, the main source of income was likely to be off-farm employment such as petty trading, artisanal trades and sale of handicrafts. Almost all (94%, N = 112) of the irrigators reported that income earned from sales of irrigated crops was used to purchase food to supplement their rainy season staple crop production, followed by the payment of school fees (84%, N = 100) and health care expenses (76%, N= 90). The total self-reported income of irrigation farmers was GH¢14,575.46 as compared to GH¢ 4,599.59 for rain-fed farmers. Out of the total income of the irrigators, GH¢12,934.98, representing 89%, came from the sale of irrigated crops. And so, all irrigators in Sumbrungu (N =17) and Winkogo (N= 41), and almost all (95%, N = 62) of those in Dorongo reported that they will continue with irrigation farming.

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The majority of respondents (60% of irrigators and 97% of rain-fed farmers) indicated that they had problems accessing extension services. Again, almost all respondents (more than 90%) reported difficulty in securing credit to buy inputs such as seeds, fertilizer and agro-chemicals.

Almost all (98%) of irrigators and majority (81%) of them reported high disease infestation of irrigated crops, especially nematodes, and poor maintenance of the schemes, as constraints to dry season farming under irrigation. Majority (81%) of irrigators reported the lack of good and readily available markets for farm produce as a challenge that needs to be addressed. Irrigators complained that there are no organized markets for their crops, especially tomato. A little less than half (43%) of irrigators and fewer rain-fed farmers (10%) reported having had access to credit to support their farming ventures during the 2012/13 farming season (data not shown).

8.3 Conclusions

Based on the findings, the following conclusions have been made:

It can be concluded that farmers engaged in irrigation farming to supplement their household food requirements and to generate income to finance long-term investments such as the payment of their children school fees, housing and acquisition of physical assets. However, landholding under irrigation in all the communities was relatively small, which does not allow many farm households to benefit from the community-based irrigation schemes.

The concept of poverty as defined by the survey respondents appears more complex and multi-layered. Instead of a narrow focus on material and measurable elements such as income, the rural farmers understood poverty as material

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deprivation; especially lack of food, income and poor health. For them the poor are those who are unable to meet their basic needs such as food, health care, shelter and clothing.

It can be concluded that the small-scale irrigation schemes in the communities provided the local people with employment year-round, helped them to improve their housing conditions, improved household nutrition, improved access to health care and enabled them pay their children school fees. Therefore, access to irrigated water directly and indirectly reduces poverty.

It is also very clear from the findings that irrigation has helped in curbing the out-migration of the youth from their communities to elsewhere in search of employment. As a result strengthens family coherence and social capital.

The results of the study indicate that access to agricultural water through the small-scale irrigation schemes has a positive impact on the food security status of rural households. The income levels of irrigators were higher than their rain-fed counterparts and majority reported using income from irrigation to buy food. Thus, the food insecurity occurrence in non-irrigating households is likely to be higher than in irrigating households. This suggests that small-scale irrigation has an important influence on rural household food security.

It can be concluded that access to irrigated agriculture increases household incomes. The results indicate that the main sources of income for irrigation farmers came from the sale of farm produce. For rain-fed farmers, the main source of income was likely to be off-farm employment such as petty trading, artisanal trades and sale of handicrafts

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Irrigation farmers inability to expand their farming ventures is due to a number of constraints, prominent among which are difficulty in securing credit to buy inputs such as seeds, fertilizer and agro-chemicals; high disease infestation of irrigated crops, especially nematodes; and poor maintenance of the schemes. Irrigators also reported the lack of good and readily available markets for farm produce as well as lack of credit as challenges that need to be addressed.

8.4 Recommendations

A number of recommendations are made.

- The study shows that smallholder irrigation can make a significant contribution towards poverty alleviation, increased incomes and food security. However, this requires the support of government, NGOs and the private in the investment of smallholder irrigation schemes. This will ensure food security, increased incomes, improved standards of living and employment creation for the rural.
- The Government and District Assemblies should develop appropriate policies and mechanisms to facilitate access to credit by small farmers.
- The Government can also play a direct role in extension service training and provision of other technical support services, like training on small-dam construction, scheme design and the production of manuals for design and management of micro-dams and water diversion structures.
- The Government through MOFA/GIDA and the District Assemblies should foster public-private partnerships (PPP) to develop and implement

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comprehensive guidelines for smallholder irrigation development in order to operationalise the National Irrigation policy.

- Marketing was reported as one of the major problems faced by irrigators. It is therefore, recommended that to enhance production and incomes, there is the need for the Bolgatanga Municipal Assembly and MoFA to assist farmers in marketing their produce, including making information about market prices of irrigated produce and the provision of storage facilities.
- In overcoming the deteriorating infrastructure the study finds the current rehabilitation highly commendable. The Ghana Irrigation Development Authority should support the Water User Associations (WUAs) technically to operate and maintain the schemes. Appropriate management structures are needed with the involvement of local people in project management.
- Though the current Ghana irrigation management policy clearly supports the participation of local people there is the need for commitment in this agenda and clear cut roles of all parties involved in the management of the schemes should be spelt.

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THE EFFECTS OF SMALL SCALE IRRIGATION DEVELOPMENT ON RURAL POVERTY REDUCTION IN THE UPPER EAST REGION, GHANA

SURVEY QUESTIONNAIRE (IRRIGATION FARMERS)

INTRODUCTION AND PURPOSE OF THE INTERVIEW

My name is _____ The purpose of this research is to examine the role of the community irrigation scheme on poverty reduction among farmers and their households. The information that you will give is purely for academic purpose and does not in any way attempt to invade your privacy. Your participation in this research is voluntary and you can choose not to take part. However, the information gathered would be beneficial to policy making so as to ensure the sustainability of irrigation schemes. You are assured that all the information provided will be treated confidentially and anonymous. There will be no way to identify that you gave this information. Please, be honest and sincere in your responses.

Could you please spare some time for the interview? Yes 1 No2

EN: Please, check for the completeness of questionnaire before leaving

Identification of questionnaire.

Name of community: [.....]

Name of interviewer.....

Date of interview...../...../.....

Time Interview Start: _____

Time End: _____

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SECTION A: DEMOGRAPHIC CHARACTERISTICS OF RESPONDENTS
[Please, tick one box only]

1. What is your sex? Male 1 Female 2

2. What is your age? >20 yrs 1 20-35yrs 2 36-51 3 52 yrs and above 4

3. What is your marital status? Married 1 Not married 2 Divorced 3

4. Have you ever attended formal school? Yes 1 No 2 [if No, skip to Qu. 6]

5. Highest level of education attained: Illiterate 1 Read and write 2 Prim/JHS/MSLC 3

6. What is your main occupation? Farmer 1 Trader 2 Artisan 3 Public Servant 4

Other (specify).....

Apart from your main occupation, what other work do you do?.....

7. What is your role in the household? Household Head (HHH) 1 Spouse of HHH 2

Child of HHH 3 Other (specify).....

9. How many of your children attend school : one 1 2 or more 2 none3

10. How long have you been living in this village : >5 years 1 6-10 years 2 10+years 3

11. Are you a registered member of the Water Users Association (WUA)? Yes 1 No 2

12. How many years in irrigation farming? 1-2 yrs 2-4yrs 2 4-6yrs 3 6-8 yrs 4 8-10 yrs 5

13. What are the factors that motivated you to go into dry season farming? supplement food needs 1 financially independent 2 meet children education others specify----------

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14. What is the main crop that you cultivated under irrigation this year?

15. Why do you select the above type of crops for your irrigation farming?

Better price 1 Good yield 2 High disease tolerance 3 Easiest to cultivate 4

Seed Availability5 Other (Specify).....

16. Other crops cultivate under irrigation [Tick all that apply] Tomatoes 1 Pepper 2 Onion 3

Leafy vegetables 4 Other (specify).....

17. Farm size (acres) cultivated under irrigation this year > 0.5 acre 0.5 to 1 acre 2

<1 acre 3

18. What methods of water application do you use? By canals 1 using buckets 2 motor pump3

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SECTION B: CROP PRODUCTION AND INCOME ASSESSMENT

19. Please the type of crop(s) that you harvested in the past 12 months and its current market value

Type of crop	Total yield (kgs)	Consumed at home(kg)	Sales	
			Qty sold	Amount

20. For what purpose do you cultivate the crop you produced under irrigation?

1. Home consumption only"1 2. Income 2 3. Both 3

21. Can you tell me the number of animals and poultry you had in this house in the past 12 months.

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Livestock holdings and their market value (the value at which the owner is willing to sell)

No.	Livestock	Number	Number sold, if any	Average local price per head	Value of livestock in GH¢
1	Bullock				
2	Donkey				
3	Cattle				
4	Sheep				
5	Goats				
6	Pigs				
7	Poultry				
8	Other livestock				
Total					

22. Apart from your income from agriculture, what are your other sources of income? (off-farm)

	Yes	No
Artisan (masonry, carpentry, etc)	1	2
Trading/business	1	2
Handicrafts (baskets, pots, mats, etc)	1	2
Remittances from relatives	1	2
Labour (construction)	1	2
Public servant/government worker	1	2

Other (specify)_____

23. Please indicate the work that you did apart from farming in the last 12 months.

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Income from non-agricultural activities for the household (if any)

No.	List of off-farm and non-agriculture related income generation activities	l income, GH¢/year
1		
2		
3		
4		
Total		

Please, how much you spent on the faming activities during last year's croping season?

No.	Farm activity	Amount(GH¢)
A	How much did you spend on tillage in the last year?	
B	If you hired Labour, how much did you spend on labour in last year?	
D	How much did you spend on farm equipment hired or bought for farming?	
E	How much did you spend to purchase seeds	
F	Water charges	
G	Fertilizer	
H	Pesticides	
I	Others expenses	

SOURCES OF INCOME

25. What is the main source of your income in a normal year? **[Tick one response]**

Sale of farm produce from irrigation 1

Sale of livestock 2

Farm labour 3

Other (specify) _____

26. How significant is the contribution of irrigation to your total annual income?

[tick only one response]

Very significant 1

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significant	2
Not sure	3
insignificant	4
Very insignificant	5

27. How satisfied are you with your income from irrigation farming in the last five years?

Very satisfied	1
Satisfied	2
Undecided	3
Dissatisfied	4
Very dissatisfied	5

Give reasons for your response_____

28. What do you normally use your income from irrigation for? (*Multiple answers possible*)

- Buy farm inputs 1
- Purchase food (cereals) for household2
- Household expenditure Health 3
- Pay children school fees (Education) 4
- Invest in other business 5
- Buy Livestock 6
- Other----------

SECTION C: FOOD SECURITY

29. What is the primary source of food for your household

Own farm	1
Purchase	2
Own farm and purchase	3

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Other (specify)_____

30. Did your household experience any food shortages in last year (2012)? Yes 1

No 2

31. If yes, how many months do you think your household was able to meet its food consumption needs from own food production

The whole year	1
More than 6 months	2
3-4 months	3

32. If No, how many months do you think your household was **NOT** able to meet its food consumption needs?

The whole year	1
More than 4 months	2
3-4 months	3
1-2 months	4
Less than 1 month	5

33. Which of the following can you say was true for your household at any point in time during the last twelve months?

1	Ate fewer meals per day	Yes□1	No□2
2	Reduced quantity of food PER MEAL	Yes□1	No□2
3	Ate less preferred food	Yes□1	No□2

34. How did you cope with the food shortage in your household during last year (2012)?

a) Borrow food stuff (cereal)	1
b) Borrow money to buy food	2
c) Relief assistance	3
d) Engage in off farm activities to generate income	4
e) Sale of animals	5

f) Others specify----------

35. What do you think are the causes of food shortages in your household?

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a) Weather vagaries 1

b) Low income level 2

c) High household size 3

d) Poor harvest 4

e) High cost of production inputs 5

f) Other (specify) _____

36. Has irrigation farming contributed to the availability of food throughout the year in your household? Yes 1 No 2

Explain_____
_____

SECTION D: SOCIO-ECONOMIC BENEFITS OF IRRIGATION FARMING

37. In your opinion what is poverty (deprivation)?

_____

_____

38. Which of the following would you consider as a sign of poverty?
poverty

	Yes	No
a) No money/income	1	2
b) No respect and dignity	1	2
c) Limited choices	1	2
d) No food	1	2

Others (specify): .....

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39. In your opinion, what are the causes of poverty in this community?

_____

_____

40. What are the characteristics of the very poor individuals/households in this community?

41. Which of the following can you say was true for your household at any point in time during the last twelve months?

1	Withdrew children from school	Yes□1	No□2
2	Borrowed cash or grain	Yes□1	No□2
3	Sold productive assets	Yes□1	No□2
4	Sold or ate reserve seeds	Yes□1	No□2
5	Sold personal effects	Yes□1	No□2

42. To what extend do you agree or disagree with the following statements (**Please tick one box on each line**)

	Indicator	Strongly disagree	Disagree	Not sure	Agree	Strongly agree
A	Irrigation has provided me and household employment during the dry season	1	2	3	4	5
B	Irrigation has help me to improve my housing condition	1	2	3	4	5
C	Irrigation helped to improve the nutritional status (diet) of my family members	1	2	3	4	5
D	Income from irrigation helps me to access health care	1	2	3	4	5
E	Income from irrigation helps me to pay children's school fees	1	2	3	4	5
F	Irrigation help reduce out-migration of youth from this community	1	2	3	4	5
G	Income from irrigation	1	2	3	4	5

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	helps me to acquire household assets (bicycles, motors, TVs, donkey carts, Motor King, etc)					
I	Irrigation helps me to acquire livestock (cattle, bullocks, sheep, pigs, etc)	1	2	3	4	5
J	Irrigation improves my annual incomes	1	2	3	4	5
K	Overall, the irrigation scheme has made very significant impact on improving the well-being of farmers/households in this community	1	2	3	4	5

43. Which of the following assets have you have bought (acquired) through irrigation farming? (**Pleased tick whichever is appropriate**)

1=Roofing sheet 1

2=Household assets (TV, radio, clothing, etc.) 2

3=Bicycle 3

4=Motor-bike 4

5= Bed and arm chairs 5

6= animals 6

7= improved farm implements/tools 7

8=others (state)

SECTION E: CHALLENGES OF IRRIGATION FARMING AND RECOMMENDATIONS

44. Is the amount of water always enough to irrigate your land? Yes 1 No 0

44. Did you have access to credit for agricultural during the last cropping season? (**if no skip to Q47**) Yes 1 No 0

45. If yes, what is the source of your credit?

	Yes	No
Banks	1	0
Own savings	1	0

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Friends/relatives	1	0
Farmer Group	1	0
Traders	1	0
Microfinance	1	0
Other (Specify).....		

46. Is credit timely and adequately available for agricultural commodities development? Yes 1 No 2

Extension Services

47. Do you receive any sort of extension services available in your locality?(**If no skip to Q60**) Yes 1 No2

48. If yes, did you gain any knowledge from the extension agents that could help you to do things differently on the specific commodities? Yes 1 No0

49. If yes, specify the knowledge gained_____

Market Information

50. What are the major challenges of irrigation farming in this community?(**Please tick which are applicable**)

	Yes	No
Lack of extension services	1	2
Lack of credit (capital)	1	2
High water pricing (water levy)	1	2
Lack of transport	1	2
Poor maintenance of irrigation facility	1	2
Disease infestation	1	2
Insufficient irrigation water		1
2		
Other (specify)_____		

51. What help do you need from the government or any organization on your irrigation farming?

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_____

_____

52. Do you have any suggestions/recommendations in order to improve irrigation farming in this community?

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