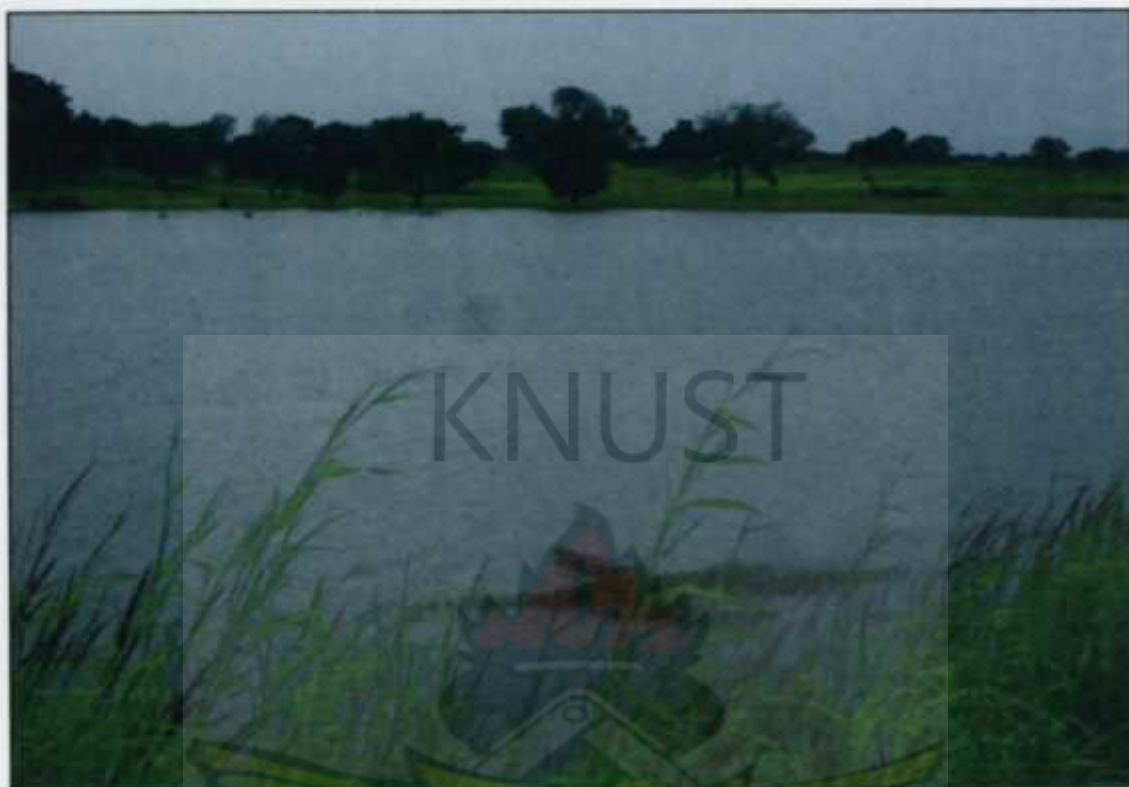


**Kwame Nkrumah University of Science and Technology
Kumasi, Ghana**



**IMPACT OF MANAGEMENT AND POLICY ON SMALL RESERVOIRS FOR
IRRIGATION IN THE UPPER EAST REGION OF GHANA**

Abaka-Yankson, Ebbin

MSc. Thesis

February 2009

**Kwame Nkrumah University of
Science and Technology**



**Faculty of Civil and Geomatic Engineering
Department of Civil Engineering**

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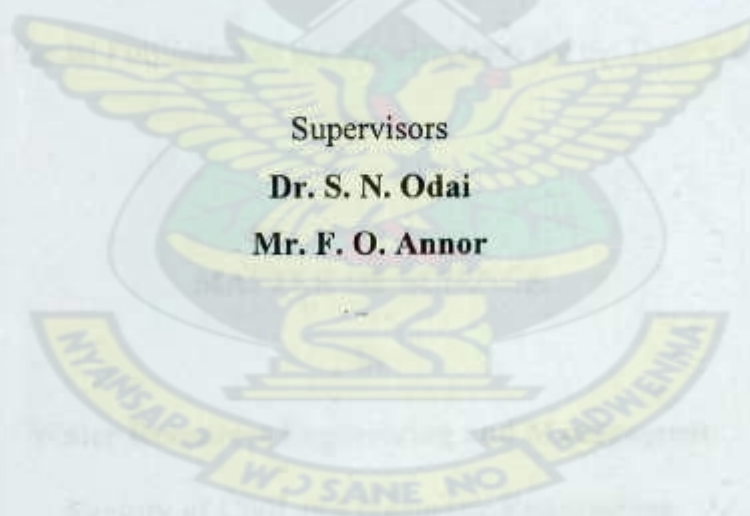
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**IMPACT OF MANAGEMENT AND POLICY ON SMALL RESERVOIRS
FOR IRRIGATION IN THE UPPER EAST REGION OF GHANA**

by

Abaka-Yankson, Ebbin, BSc. (Hons)

KNUST

A thesis submitted to

the Department of Civil Engineering,

Kwame Nkrumah University of Science and Technology

in Partial Fulfilment of the Requirements for the Degree of

MASTER OF SCIENCE

in

Water Resources Engineering and Management

Faculty of Civil and Geomatic Engineering

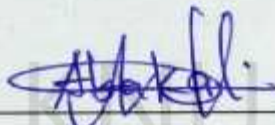
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CERTIFICATION

I hereby declare that this submission is my own work towards the MSc. and that, to the best of my knowledge, it contains no material previously published by another person nor material which has been accepted for the award of any other degree of the University, except where due acknowledgement has been made in the text.

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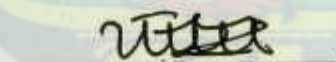
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Dedication

To my parents and siblings

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Abstract

Many small dams have been constructed in the Upper East Region (UER) of Ghana to address the problem of water scarcity and to help bring security to the livelihoods of the people in the region. Small reservoirs are important for socioeconomic development in the UER, without which the livelihood of many communities would be jeopardized. The reservoirs are a widely used form of infrastructure in the Upper East Region for the provision of water mainly for irrigation and for livestock watering, fishing, and domestic use. Government developed strategic policies aimed at increasing and improving dry season irrigation farming in the region. As a result, considerable attention was given to the development of Water Users Associations (WUAs) capable of managing the schemes. There is thus, the need to assess the impact of government policies and management by WUAs on the small reservoirs for irrigation. This study assesses the impact of management and policy on small reservoirs for irrigation in the UER. Nine small reservoirs were selected for the study. Participatory Rural Appraisal (PRA) tools were used namely, semi-structured interviews, focus group discussions and one-to-one discussions. The results of the study show that the impact of government policies and management functions by the WUAs have been the recognition and increased sense of ownership of these reservoirs by the beneficiary communities which has resulted in increased financial mobilization leading to timely repairs of damaged dam infrastructure and protection of the scheme; the growth and appreciation of participatory culture which led to the increase in number of women involved in dry season farming and the smooth democratic change of leadership between the periods 2001 and 2004 at all the dam sites visited; the application of enough fertilizers leading to increased farm yields. From the study it can be concluded that by harmonizing the interests of individuals served by small multi-purpose reservoirs through the formulation and implementation of policies coupled with proper management, the goal to improve food security at the household level and increase sustainable livelihoods in the UER could be attained.

Table of Content

Abstract.....	vi
List of Tables	xi
List of Acronyms	xii
Acknowledgements	xiii
 CHAPTER ONE	 1
1.0 INTRODUCTION	1
1.1 Background of study.....	1
1.2 Objectives of the Study.....	6
1.3 Rationale of the Study	6
1.4 Scope of Work.....	8
1.5 Organisation of Report	8
 CHAPTER TWO	 9
2.0 LITERATURE REVIEW	9
2.1 Small Water Reservoirs in Upper East Region (UER).....	9
2.2 Multiple Uses of Small Reservoir Water Systems	10
2.3 Operational Rules Governing the Use of Reservoir Water	11
2.4 Land Tenure and Land Use in the UER	12
2.4.1 Rights in Land	12
2.4.2 Succession of Land.....	12
2.4.3 Women's Rights to Own and Use Land.....	13
2.5 Management of Reservoir Water Resources	13
2.6 Irrigation Policy on Small Reservoir Development	15
2.7 The Ghana Irrigation Policy	16
2.8 <u>Limitations of Reservoir</u> Water Resources Management in the UER.....	17
 CHAPTER THREE	 18
3.0 STUDY AREA	18
3.1 Geographical Location and Administrative Boundaries	18
3.2 Climate.....	19
3.3 Geology, Soils and Relief.....	20
3.4 Drainage System.....	20
3.5 Vegetation.....	21
3.6 Socio-Economic Attributes.....	21

CHAPTER FOUR	23
4.0 METHODOLOGY	23
4.1 Desk Study	23
4.2 Data Collection	23
4.3 Reconnaissance Survey and Field Measurement	24
4.4 Semi-Structured Interviews	24
4.5 Questionnaire Administration	25
4.6 Focus Group Discussions	25
4.7 Site Selection	26
CHAPTER FIVE	29
5.0 RESULTS AND DISCUSSION	29
5.1 Management of Small Reservoirs for Irrigation in the UER of Ghana	29
5.1.1 Past Experience (Baseline)	29
5.1.2 Present Trends	30
5.2 Stakeholders in the Management of Small Reservoirs in UER	31
5.2.1 Role of Stakeholders in the Management of Small Reservoirs in UER	31
5.2.2 Strengths and Weaknesses of Stakeholders	33
5.3 The Water Users Associations (WUAs)	33
5.4 The Management Functions of a WUA	34
5.5 Indicators and Benchmarks for Measuring the Performance of WUAs	35
5.5.1 Indicators for Measuring the Performance of WUAs	35
5.5.2 Performance Benchmarks of the WUAs	36
5.6 Reservoir Case Studies	37
5.6.1 Management of Irrigable Area	37
5.6.2 Water Management Functions	38
5.6.3 Crop Production	39
5.6.4 Formulation and Enforcement of Bye-Laws and Conflict Resolution	40
5.7 Impact of Management on Small Reservoirs for Dry Season Irrigation	41
5.8 Policy Impact on the Use of Small Reservoirs for Irrigation in UER	50
5.9 Policies influencing the use of the Small Reservoirs for Irrigation	51
5.10 Impact of the Policies on the use of the Small Reservoirs for Irrigation	53
CHAPTER SIX	57
6.0 CONCLUSIONS AND RECOMMENDATIONS	57
6.1 Conclusions	57
6.2 Recommendations	58

REFERENCES	59
APPENDICES.....	64
APPENDIX A: Questionnaire.....	64
APPENDIX B: Reservoir Data Base.....	68
APPENDIX C: Interview/Talk.....	70
APPENDIX D: Financial Mobilization and Training Support.....	71

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List of Figures

Figure 1: Upper East Region and its Districts	18
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List of Plates

Plate 1: Small Reservoir (Telania).....	1
Plate 2: Administration of questionnaire to a WUA executive at Anateem.....	25
Plate 3: Focus group discussion with WUA members and executives at Doba.....	26



List of Tables

Table 4.7-1: List of small reservoirs and their geographic locations	28
Table 5.2-1: Role of Stakeholders in Management of Small Reservoirs	32
Table 5.7-1: Level of Financial Mobilization by WUAs	43
Table 5.7-2: Nature of repairs/maintenance by some WUAs.....	45
Table 5.7-3: Condition of the Catchment Areas of Dams	46
Table 5.7-4: Use and Control of Irrigable Lands at the Dam Sites	41
Table 5.7-5: Conflict Type and Resolution by some WUAs.....	48
Table 5.10-1: Impact of Fertilizer Subsidy.....	54
Table 5.10-2: Year and Type of Rehabilitation of the Dams	55
Table 5.10-3: Women Involvement in Dry Season Irrigation.....	56



List of Acronyms

AEA	Agriculture Extension Agent
CBRDP	Community Based Rural Development Project
DCE	District Chief Executives
DMC	Damsite Management Committee
DOC	Department of Cooperation
EPA	Environmental Protection Agency
FAO	Food and Agriculture Organization
FBO	Farmers Based Organisation
IDA	Irrigation Development Authority
GPS	Global Positioning System
ICOUR	Irrigation Company of Upper East Region
IFAD	International Fund for Agriculture Development
LAC	Land Allocation Committee
LACOSREP	Land Conservation and Smallholder Rehabilitation Project
MoFA	Ministry of Food and Agriculture
NGO	Non-Governmental Organisation
NPK	Nitrogen Phosphorus Potassium
RHC	Regional House of Chiefs
SRP	Small Reservoirs Project
UER	Upper East Region
WRC	Water Resources Commission
WRDC	Water Resources Development Component
WUA	Water Users' Association
WVR	White Volta River
ZOVFA	Zurich Organic Vegetable Farmers Association

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CHAPTER ONE

1.0 INTRODUCTION

1.1 Background of study

People living in arid areas with highly variable rainfall, experience droughts and floods and often have insecure livelihoods. Small reservoirs are a widely used form of infrastructure for the provision of water. They make available water for domestic use, livestock watering, irrigation, and other beneficial uses in the dry season (Poolman, 2005).



Plate 1: Small Reservoir (Telania)

In an area such as the Upper East Region (UER) of Ghana, where the population lives with highly variable rainfall and experiences drought, catching and storing freshwater that falls as rain during the rainy season is essential in order to cope during the dry season. The stored water can help bring security to the livelihoods of the people since it can be used for irrigation, domestic use, and livestock watering during a period

where otherwise there would be very little water available (Poolman, 2005). Plate 1 is a small reservoir at Telania in the Kassena Nankana District of the UER.

According to Ghana's year 2000 population and housing census (GSS, 2002) the region has a population of 920,089, made up of 442,492 males and 477,597 females, and with a population growth rate of 1.1%. Indeed, the Upper East Region has the highest inhabited population density (104.1 persons per sq. km) of all regions of Ghana. The UER is among the three poorest regions in Ghana. Agriculture employs above 80% of the adult population, making this sector key to socioeconomic growth for the region. To improve the difficult natural conditions in the UER of Ghana, the Ghanaian government, with assistance from foreign donors, developed irrigation schemes from the mid 1960s to the 1970s (Gyasi, 2005).

It was apparently the target of policy makers that such irrigation developments would replace indigenous soil and water conservation methods which, was argued, could no longer cope with the pressures from an increasing population, environmental degradation and changes in climatic conditions. Irrigation schemes were developed in order to bring the economy of the northern regions in line with that of the southern regions of the country and to provide domestic substitutes for certain agricultural products imported during that time (FAO, 1968).

Food crops and high-value crops such as, onions, tomatoes, pepper, and traditional leafy vegetables are produced from the irrigation schemes in the area during the dry season (Gyasi, 2005).

The region has a uni-modal rainfall with an average annual rainfall approximately 1100 mm/year. Typically the rainy season in the area starts from late May and ends mid-October, characterized by low and erratic rainfall and a dry season from November through early May (Faulkner, 2006).

The long dry season often results in the drying up of most natural sources of water in the area, so that years of little rain or prolonged drought in the rainy season have great implications for all year round water availability for domestic use, livestock consumption and dry season gardening, which constitute the major uses of water in rural communities in the Upper East Region of Ghana (Gyasi and Schiffer, 2005).

The reservoirs in the Upper East Region are used for the provision of water mainly for irrigation and for livestock watering, fishing, and domestic use, wildlife watering, harbouring crocodiles and recreational purposes. Also, when water levels in the reservoirs run low, the reservoir's bed can be exploited in order to make bricks out of the clay-rich soil for the construction of houses.

At the moment there are approximately 160 reservoirs in the Upper East Region located on streams and rivers which are in the upstream of the Ghana portion of the Volta Basin with an estimated total surface area of 3,329 ha. At full storage capacities, 293 MCM of water can be captured during the rainy season (Poolman, 2005).

Without these reservoirs and corresponding irrigation systems, many farmers would be forced to travel away from their homes to labour elsewhere. In the UER, large numbers of small reservoirs serve the scattered rural population with water (Faulkner, 2006).

Most of these small reservoirs have been constructed in the past in a series of projects funded by different agencies in order to help bring security to the livelihoods of the people in the region (Andreini *et al*, 2005). For more than a decade now, the International Fund for Agricultural Development (IFAD) has been extensively involved in small reservoir-based livelihoods interventions in Northern Ghana which comprised the three poorest regions of the country. One of the most notable IFAD activities has been the construction and rehabilitation of small reservoirs in the UER. This was done through the Water Resources Development Component (WRDC) of the Land Conservation and Smallholder Rehabilitation Project (LACOSREP) phases I & II from 1992 to 2006. The aim was to create opportunity for all year round cultivation in the region.

As a result, considerable attention was given to the development of capable and sustainable local level water governance structures (Water Users' Associations - WUAs). Management responsibilities of the WUAs at the dam sites include regular operation and maintenance of the infrastructure, fair (seasonal) distribution and allocation of land and water, conflict mitigation between different user groups, collection of water user fees, etc.

Amongst others they were ideally supposed to take over control of the irrigable land in the dry season from the original land owners through negotiated access rights. However, in the rainy season the original land owners would mostly take back control over the land and cultivate it until the next dry season i.e. seasonal tenureship is common in most small reservoir schemes managed by WUA. The long term aim for the WUAs is to ensure sustainable management of this established and rehabilitated infrastructures and thereby enhancing the livelihoods of the WUA members.

The government through the Ministry of Food and Agriculture (MoFA) is implementing some policies as far as dry season irrigation farming using the small reservoirs are concerned. These policies are aimed at increasing and improving dry season irrigation farming in the region. These include rehabilitation and construction of small reservoirs, subsidies on fertilizers, amongst others.

There have been increasing complaints by the users of these reservoirs and other stakeholders that they are not being well maintained resulting in the occasional collapse of some reservoirs. This problem of water scarcity affects the livelihoods of the people since they mainly depend on agriculture (Poolman, 2005).

However, the sustainability of the reservoirs is being challenged by problems which directly affect the livelihoods and the economic development of the people. In the dry season, many of the reservoirs dry up resulting in a reduction or total loss of the aforementioned benefits (Adwubi, 2008).

1.2 Objectives of the Study

The main objective of this study is to determine the impact of management and policy on small reservoirs for irrigation in the UER of Ghana.

The specific objectives of this research are to identify:

1. Stakeholders involved in the management of the small reservoirs.
2. The management functions and operations of WUAs and its impact on small reservoirs for irrigation.
3. The policies influencing the use of small reservoirs for irrigation.

1.3 Rationale of the Study

Small reservoirs are important for socioeconomic development in the UER, without which the livelihood of many communities would be jeopardized. These reservoirs provide water for many uses, ranging from irrigation, livestock watering and fisheries to domestic uses. In the 1960s and 1970s various development cooperation organizations were involved in funding projects whereby small reservoirs were constructed in the UER in order to help rural communities obtain sufficient water to improve food security at household level and increase sustainable livelihoods. Strategic policies were formulated and implemented by government to achieve this goal.

Most of the reservoirs were constructed in a series of projects funded by different agencies, at different times, with little or no coordination among the implementing partners. Such array of uses of the water in the reservoirs, do however, sometimes lead to problems concerning maintenance, payment and ownership of the water and land surrounding the small reservoir.

The sustainable management of these resources is therefore crucial for socio-economic well-being of the people in the region. This suggests that there is the need for improvement in the planning, operation, and maintenance of these small reservoirs. There is thus the need to assess the impact of management and policy on the use of the reservoirs. This would be used to ensure that newly built multi-purpose reservoirs will be properly operated and maintained in sustainable fashion, and economically viable while assuring they improve the livelihoods of the local residents.

Undertaking this study is important because at the end of the study, the results can be applied in similar small reservoirs nationwide as far as their management and policies are concerned. In addition, the results of the study can be used as a basis to develop a decision support tool for planning efficient management strategies to allow efficient use of small reservoir water for irrigation.

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1.4 Scope of Work

This study intended to achieve the above objectives by drawing on case studies from small reservoirs used for irrigation in Ghana. The study was limited to the Upper East Region, where nine (9) small irrigation reservoirs were investigated.

1.5 Organisation of Report

The thesis is organized into six chapters. Chapter 1 introduces the project with a background, the aim and the specific objectives as well as the justification and scope of the research. Chapter 2 reviews literature on the impact of management and policy on the performance of small reservoirs for irrigation. Chapter 3 describes the study area. Chapter 4 describes the methodology applied. Chapter 5 discusses the results. Chapter 6 concludes on the impact of management and policy on the small reservoirs for irrigation and gives recommendations.

CHAPTER TWO

2.0 LITERATURE REVIEW

2.1 Small Water Reservoirs in Upper East Region (UER)

Water reservoirs in the UER are spatially distributed according to topographic controls within the region. More reservoirs are located in the eastern half of the region and fewer in the western half. The eastern half, which mainly lies above the regional mean elevation, is characterized by drainage boundaries that fold back and forth providing favourable conditions for reservoir construction (Mdemu, 2008).

Small reservoirs can provide an opportunity to deal with inter-year rainfall variation by providing storage for a significant quantity of water. This water can then be used during the dry-season for various activities. Furthermore, the small reservoirs have a significant effect on downstream flows since they provide a buffer so that floods are delayed and diminished because water can be (temporarily) stored. This is necessary because the intensity of the rain can exceed the absorptive capacity of the soil, creating high amounts of runoff with erosion being one of the most significant agricultural constraints in the region (Poolman, 2005).

Currently, there are about 160 reservoirs in the UER with an estimated total surface area of 3,329 ha. Seventy percent (70%) of this area is contributed by the medium reservoirs, Tonö (1,894 ha) and Veä (435 ha). Small reservoirs, managed primarily by Water Users Association (WUA) and ranging from 1 to 35 ha in size, contribute the remaining 30%. At full storage capacities, 293 MCM of water can be captured during the rainy season (ICOUR, 1995).

However, the reservoir storage volume decreases gradually due to abstraction, evaporation and other outflow components from maximum storage at the end of the rainy season to minimum or zero storage between February and May, depending on the size of and demands for reservoir water (Mdemu, 2008).

2.2 Multiple Uses of Small Reservoir Water Systems

Small reservoirs in the UER were developed mainly to provide water for irrigation in order to increase food crop production, and to supply water for human and livestock needs. Increased coverage of potable water supply via portable pipe or pumped boreholes in many rural areas of the UER has created the opportunity for fishery water use within the reservoirs, thus designating irrigation, livestock and fishery as the three most important uses of reservoir water resources in the region.

Crop irrigation, however, constitutes the largest user of the reservoir water. People with access to land at the irrigation areas describe vegetable gardening as their main activity and source of income in the dry season. The reservoirs of the community dams also serve as fish habitats and the source of protein for many of the rural dwellers. Efforts have been made by the fisheries department of MoFA to stock some reservoirs with fingerlings, as a way of promoting fish culture in the region (Gyasi and Schiffer, 2005).

Livestock is a major source of income for many of the households and also plays a very important role in the funerals and the traditional dowry system in the area. Lack

of water affecting the livestock therefore impacts significantly on local livelihoods. Availability of water in the reservoir reduces livestock losses through theft, which is a major occurrence in the dry season when the animals stray far away in search of water. Livestock watering is confined to the main reservoir, and few cases of watering from irrigation canals can be observed because the water flows in the laterals or canals during irrigation events only. However, few incidences of livestock watering in canals and main drains can be observed in some of the small reservoirs that have relatively longer-duration irrigation events of more than 3 hours.

Use of reservoir water for domestic (cooking, drinking, sanitation, and house construction) is very common for communities living along the secondary canals and surrounding the reservoirs. Water is drawn from the reservoir for bathing and laundry (Mdemu, 2008).

2.3 Operational Rules Governing the Use of Reservoir Water

In the event of scarcity, communities develop hierarchies of water uses according to their importance. It is generally agreed that the most important water use was human drinking water (however people hardly use it for drinking purposes since they own bore holes), closely followed by watering livestock. Only when these two needs were secured that the excess water is used for irrigation and other uses like construction of mud houses (Gyasi and Schiffer, 2005).

2.4 Land Tenure and Land Use in the UER

2.4.1 Rights in Land

The majority of lands in the UER are under a customary land tenure system. The land is entrusted to the '*tendana*', literally meaning the owner of the land who is the custodian. The '*tendana*' is normally the patrilineal descendant of the first family to settle in the area. Tendamba (plural of '*tendana*') are spiritual caretakers of land resources and grant usufruct customary rights to community members for free (Gyasi, 2005).

However each family's land is secure and controlled by the families as long it is used for what it was allocated for. Although a similar land tenure system is applied for irrigated lands, two types of arrangements for land ownership exist: a secure tenure wherein users of irrigation facilities have total control over the command area, and seasonal tenureship, common in most small reservoir schemes managed by WUA, whereby land is returned to the original landowning families in the rainy season (Gyasi, 2005).

2.4.2 Succession of Land

Since succession is patrilineal, land is inherited by a man's sons, with the eldest son inheriting a larger share. Men commonly give away all or some of their land in advance for inheritance, either to avoid quarrels on their death, or because they no longer need to use it themselves.

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2.4.3 Women's Rights to Own and Use Land

Women do not have the rights to own lands. However, they do have a long established right to borrow land from their husbands or male kin to cultivate a crop of their own. If a woman is unable to obtain land from these men, she will negotiate the loan of land from another compound.

2.5 Management of Reservoir Water Resources

The Water Resources Commission (WRC) Act (1996) specifies that ownership and control of all water resources are vested in the President on behalf of the people, and designates the WRC as the body with overall responsibility for water resources management in Ghana. The WRC plans and regulates water resources development in co-operation with local government and planning authorities.

The LACOSREP, during its first and second phases of operation in the UER, included elements of the WUA as an important strategy for the sustainability of rehabilitated small reservoirs upon project completion and the handing over of rehabilitated reservoirs to beneficiary communities. The formation or prior existence of a functional WUA was in fact a prerequisite for a given community to have its dam rehabilitated. Currently, nearly all rehabilitated small reservoirs are managed under WUAs (Gyasi, 2005).

In many of the communities, the WUA is an umbrella organization of user groups made up of gardeners, fishermen and livestock owners who have stakes in the dam

infrastructure and services. Elected representatives of the user groups constitute the damsite management committee (DMC), which is responsible for the management of the system. A typical DMC consists of a chairman, secretary and a treasurer. In most cases the term of committee members was 3 years. Elections are preceded by nominations of names of members for approval, and voting is conducted if more than one person is nominated for a position. The executive committee is made up of men and women (Gyasi and Schiffer, 2005).

The DMC, together with the community members, agree on the water levy at the beginning of the season. The levy is a fixed sum, identical for every participating farmer in the community. The WUA's contributions are used for repairs and maintenance of irrigation canals, dam walls, valves and spillways. The Irrigation Development Authority (IDA) is in principle required to provide technical personnel to support WUAs in the management of the small reservoirs when the need arises (Mdemu, 2008).

2.6 Irrigation Policy on Small Reservoir Development

Irrigation policy is about the role of the state in promoting or providing irrigation facilities. It is also about policy choices that exist with respect to alternative irrigation technologies and the management of the scheme (Ellis, 2005).

In a number of countries, there has been the policy of substantial shift of resources from new construction to rehabilitation and upgrading of infrastructure and management of existing irrigation systems (Martin, 2005). Governments are giving increased responsibility to Community Based Organizations (CBOs) to manage irrigation schemes. In general, devolution in irrigation management aims at promoting active involvement of local people and it often involves the formation of organizations of formal user groups known as Water Users Associations (Gyasi, 2002).

The concept of devolution in irrigation management ranges from participation of farmers in irrigation management to irrigation management transfer. The former refers to increasing farmer responsibility and authority at some or all levels and aspects of irrigation management whilst the latter involves a complete shift of management from a government irrigation agency to an autonomous local level organization controlled by water users or which the water users have a substantial voice (Meinzen-Dick et al., 1997). Irrigation management transfer alone has not resulted in an appreciable improvement in crop yields, the quality of irrigation services, or the value of agricultural production. Also, rehabilitation alone has not created significant effects. But, where both rehabilitation and management transfer

have occurred, significant improvements in agricultural productivity levels and returns to land have been observed (Samed and Vermillion, 1999).

Indeed, the performance of community-based institutions in the management of traditional irrigation schemes has motivated a lot of donor support for small-scale irrigation schemes under community management as a means of empowering the local people. In Northern Ghana, for example, IFAD through its assisted regional agricultural development projects has funded the construction and rehabilitation of communal managed dams in the Upper Regions of Ghana (Gyasi and Schiffer, 2005).

2.7 The Ghana Irrigation Policy

The objective of irrigation policy is to expand and improve the efficiency of irrigation to support agricultural development and growth. It will be pursued with principles of sustainability in operation and maintenance, and use of natural resources, equitable access by women to benefits of irrigation, and the rights to participate in irrigation management (MoFA, 2007).

The policy is designed to address four key 'problem' areas concerning the formal, informal and commercial irrigated sub-sectors. These problems are: low agricultural productivity and slow rates of growth, constrained socio-economic engagement with land and water resources, environmental degradation associated with irrigated production and lack of irrigation support services (MoFA, 2007).

The goal of the policy is to achieve sustainable growth and enhance performance of irrigation contributing fully to the goals of the Ghanaian agriculture sector. The

targets of the Ghana Irrigation Policy are to attain national food security, increase livelihood options, intensify and diversify production of agricultural commodities (MoFA, 2007).

2.8 Limitations of Reservoir Water Resources Management in the UER

Although small reservoirs tend to function better than the larger irrigation schemes found in Ghana, they often do malfunction. The main problem is lack of simple maintenance, which in turn leads to spillway erosion, dam wall failures, canal and lateral deterioration, and reservoir siltation (Small Reservoir Project, 2005).

The presence of deteriorated water conveyance infrastructure, which can no longer properly retain water, thus making control of water a difficult task, is a major constraint to improved reservoir water resources management. Inadequacy of irrigation water management personnel is also a constraint to the management of reservoir water resources (Mdemu, 2008).

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CHAPTER THREE

3.0 STUDY AREA

3.1 Geographical Location and Administrative Boundaries

This study was conducted in the UER of Ghana within the White Volta tributary of the Volta River Basin. The Upper East Region of Ghana is the north-easternmost part of Ghana's ten regions. It is located between latitudes $10^{\circ} 30'$ and $11^{\circ} 15'$ north and longitudes 0° and $1^{\circ} 30'$ west (IFAD, 1991). It covers a land surface area of 8860 km^2 . The UER borders internationally with Burkina Faso to the north and Togo to the east and regionally with the Upper West and North Regions to the west and south, respectively. It is administratively divided into the nine districts namely: Bawku East and West, Garu Tempani, Talensi Nabdam, Bolgatanga, Kassena-Nankana East and West, Bongo and Builsa (Fig. 1). The regional capital is Bolgatanga.

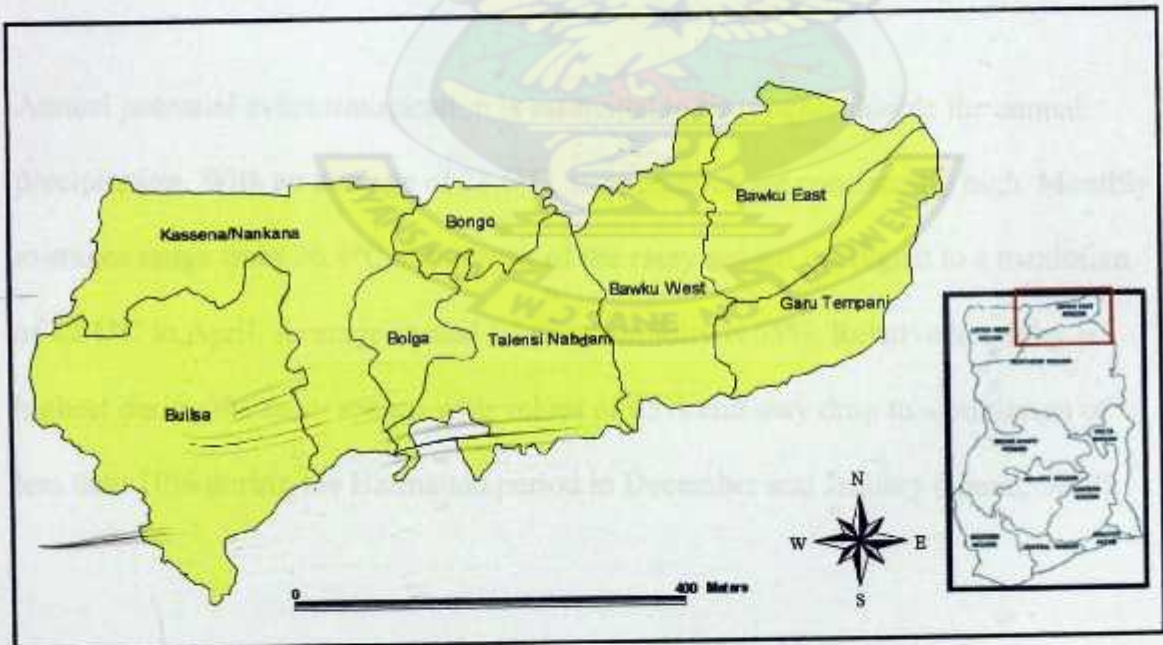


Figure 1: Upper East Region and its Districts

3.2 Climate

The climate of the region is influenced by the movement of two types of air masses: the harmattan and monsoon winds, which control the climate of the West African sub-region. The harmattan, or North East (NE) trade winds, originate from the Sahara desert and are characterized by dry and particle-laden air masses. The southwestern (SW) monsoon winds carrying moist air from the Gulf of Guinea bring rains upon converging with the NE trade winds (Mdemu, 2008).

The UER is characterized by a uni-modal rainy season starting in April-May and lasting into September or the beginning of October. Rainfall is erratic and spatially variable. Average annual rainfall is between 700 and 1010 mm per year with peak rainfall occurring in late August or early September (Kranjac-Berisavljevic et al., 1998).

Annual potential evapotranspiration is estimated to be roughly double the annual precipitation. With an average of 28.6°C, temperatures are consistently high. Monthly averages range from 26.4°C at the peak of the rainy season in August to a maximum of 32.1°C in April. Average annual relative humidity is 55%. Relative humidity is highest during the rainy season with values of 65% and may drop to a minimum of less than 10% during the Harmattan period in December and January (Liebe, 2002).

3.3 Geology, Soils and Relief

The geological formations covering the Upper East Region are divided into three main groups, the Granitic, Voltaian, and Birrimian rocks.

Soils in the area are generally formed by weathering of the bedrock although some drift of soil transported by wind and water is also found. The soils have predominantly light textured surface horizons with heavy textured soils confined to valley bottoms. There are extensive areas of shallow concretionary and rocky soils which have low water holding capacities and limited suitability for agriculture (Quansah, 1999).

The relief of the UER is related to the geology. Areas occupied by granites are generally of low, gently rolling relief ranging from 122 m to 260 m above sea level. The relief under Voltaian rocks rises above 518 m near the border with Togo in the east. The mean elevation for the region is 197 m above sea level (Mdemu, 2008).

3.4 Drainage System

The UER is largely drained by the White Volta River (WVR), with nearly all small and medium tributaries from various sub-catchments in the northern segment of the region draining southward into the WVR. In the west, the region is drained by the Sisili River, which joins the WVR in the southwest corner of the UER. Areas between Bongo and Zebilla on the western side of the WVR are drained by the Red Volta

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River. The areas north of Bolgatanga and large parts of Navrongo are drained by the Atankwidi subcatchment (Mdemu, 2008).

3.5 Vegetation

The vegetation is Sudan savanna consisting of short drought and fire resistant deciduous trees interspersed with open savanna grassland. Grass is very sparse and in most areas the land is bare and severely eroded (Adwubi, 2008). Overgrazing is evident in some areas particularly near ponds and dams, since the region has the highest density of cattle (IFAD, 1991). Common grasses include *Andropogon gayanus* which can be found in less eroded areas and *Hyperrhenia spp.*, *Aristida spp.* and *Heteropogon spp.* in the severely eroded areas. Common trees include *Anogeissus spp.*, *Acacia spp.* and *Triplochiton spp.* (Adwubi, 2008). Others include *Alstonia digitata*, *Vitellaria paradoxia* and Dawadawa.

3.6 Socio-Economic Attributes

The UER is among the three poorest regions in Ghana. Agriculture employs 80 % of the adult population. The population of the UER is ethnically diverse, comprising different ethnic groups that speak different languages. The population density in the region is high, i.e., about 104.1 persons per km², compared with national population density of 77 persons per km². Land is scarce and the incidence and depth of poverty is high.

The irrigation schemes are vital for increasing food security and rural income by providing water for dry season farming, livestock and fishery (Gyasi, 2005). Food crops and high-value crops such as onions, tomatoes, pepper, and traditional leafy vegetables are produced from the irrigation schemes in the area during the dry season which is managed by the WUAs. During the wet season, farming is done mainly by land owners. Crops that are usually grown during this period include millet, sorghum, groundnut, maize and rice.

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CHAPTER FOUR

4.0 METHODOLOGY

This section discusses the selection criteria and the methodologies used for the study. The data required for the analysis were obtained using Participatory Rural Appraisal (PRA) tools namely, semi-structured interviews and questionnaire, focus group discussions and one-to-one discussions. Desk Study, Reconnaissance Survey and Field Measurements were also done.

4.1 Desk Study

A desk study of relevant literature from project reports done in the Upper East Region and documents of stakeholder institutions and organizations in Ghana was undertaken with the aim to fully understand the management and policy pertaining to small reservoirs for irrigation in the UER.

4.2 Data Collection

The first fieldwork started with initial visits to institutions and organizations involved in water and land management and usage in the region. They are Water Resources Commission (WRC), Ministry of Food and Agriculture (MoFA), Irrigation Development Authority (IDA), Zurich Organic Vegetable Farmers Association (ZOVFA), where stakeholder discussions were undertaken. This was followed by visits to the dam sites where field measurements were taken. Focus-group discussions were conducted at all the reservoir sites.

The second fieldwork was undertaken to see the activities which go on during the dry season irrigation farming. Follow-up interviews were conducted at all the reservoir sites to validate the data collected during the first field visit. Measurements of plot sizes, canals and laterals dimensions were also done.

4.3 Reconnaissance Survey and Field Measurement

The various small reservoir sites were visited to observe and take inventory of the existing conditions. The following were done during the survey:

- The locations of the nine (9) small reservoirs were recorded with a handheld Global Positioning System (GPS).
- Measurement of the surface areas of the reservoirs using the GPS.
- Methods of irrigation, physical conditions of canals and laterals.
- Measurement of flow, plot sizes, canals and lateral dimensions.

4.4 Semi-Structured Interviews

Interviews were conducted with the following stakeholders:

- Stakeholders including core key government institutions (WRC, MoFA, IDA, ICOUR, RHC, CBRDP, ZOVFA)
- Local NGOs (Rural Aid, Catholic Secretariat)
- Key Informants and opinion leaders.

Staffs from these institutions and organizations and persons were interviewed on matters pertaining to their roles in the management of the reservoirs.

4.5 Questionnaire Administration

Questionnaires were administered to both the executives and the members of the Water Users Association. The questionnaires used for the study are presented in Appendix A.



Plate 2: Administration of questionnaire to a WUA executive at Anateem

4.6 Focus Group Discussions

Based on the results obtained from the interviews with the stakeholders, focus group discussions were organized for both the executives (also known as Damsite Management Committee, DMC) and the members of the Water User Associations at all the reservoir sites to authenticate the outcome of the interviews.

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This approach was adopted to explore the range of opinion and views on the issue.



Plate 3: Focus group discussion with WUA members and executives at Doba

4.7 Site Selection

The selection of the dam sites to be surveyed for collection of the necessary data was guided by the following criteria:

- There are two basic ways in which reservoirs (small, medium and large) can be classified. One is by the volume of water contained in the reservoir. This can be done by conducting a bathymetric survey on the reservoir. In most of the reservoirs in the UER bathymetric survey has not been done on them. An alternate approach of classification is by the surface area of the reservoirs. According to ICOUR (1995), small reservoirs are those with surface area between 1 and 35 ha. It is easier to compute the surface area of small

reservoirs using a handheld GPS and hence, the latter was used as a basis for selecting the small reservoirs.

- Perceived “successful” performance of the Water Users Associations (WUAs), relying on information from extension staff of MoFA and IDA. This is to acknowledge some of the best practices that have evolved over the years in the manning and use of irrigation infrastructure manifested in the continuous use of the facility under the auspices of a well functioning WUA, while at the same time taking cognizance of some of the very bad practices in facility management and use manifested in either non-use or only intermittent use of the facility.

Nine reservoirs were selected for the study based on the afore mentioned criteria and on existing reservoir database. Table 4.7-1 gives a brief description of the nine reservoirs.

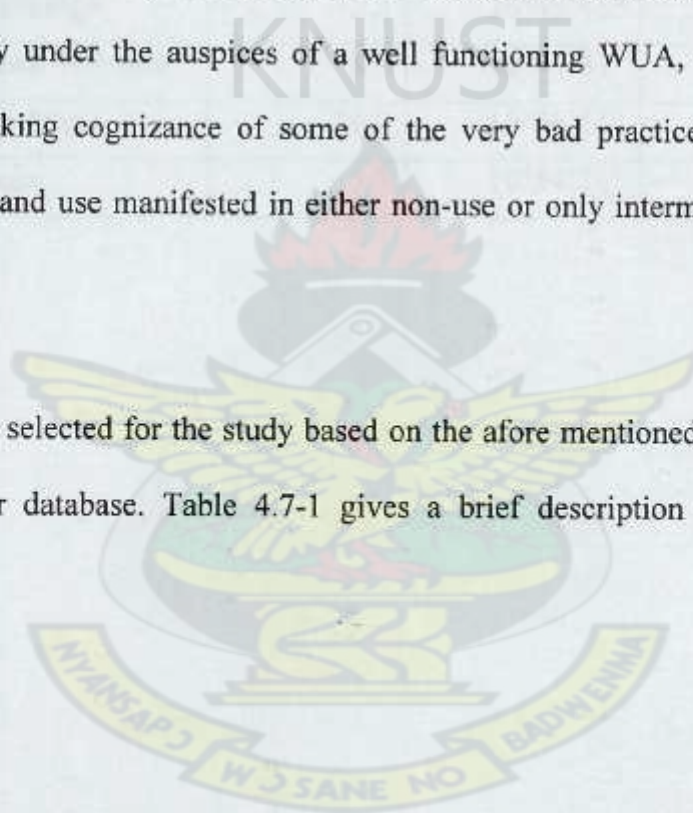


Table 4.7-1: List of small reservoirs and their geographic locations

Name of dam	District	Surface Area (ha)	Location of reservoir	
			Longitude (N)	Latitude (W)
Taleana	Kassena-Nankana	16.0	10°55'32"	1°03'32"
Anateem	Bolgatanga	5.3	10°49'07"	0°56'57"
Baare	Bolgatanga	14.2	10°44'28"	0°47'36"
Doba	Kassena-Nankana	6.2	10°51'59"	1°02'12"
Nyangania	Kassena-Nankana	15.5	10°50'59"	1°11'35"
Sumbrugu	Bolgatanga	5.2	10°49'45"	0°56'16"
Bolga-Soe	Talensi-Nabdam	8.8	10°47'51"	0°50'54"
Dorongo	Bolgatanga	21.0	10°46'54"	0°53'21"
Bongo Central	Bongo	5.8	10°54'34"	0°47'27"



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CHAPTER FIVE

5.0 RESULTS AND DISCUSSION

5.1 Management of Small Reservoirs for Irrigation in the UER of Ghana

5.1.1 Past Experience (Baseline)

In the past, formulation and implementation of projects were mainly done by Government through its line agencies without much involvement of the beneficiary communities. The responsibility of management, operation and maintenance therefore rested on the government. This is the same situation we find with the construction of dams/irrigation schemes (medium and small) in the country and in particular Northern Ghana (UER-LACOSREP, 1999).

The management and operation of these small irrigation schemes were directed by the Irrigation Development Authority under the auspices of MoFA, through Technical Officers and Technical Assistants. They controlled and regulated the delivery of irrigation water to farmers, partitioning and allocation of land and even, dictated the type of crop to be planted. The planning and execution of maintenance activities at these schemes were the prerogative of the Irrigation Development Authority employing paid labour to do field work.

Because the technical officers and assistants were not regular in discharging their functions the schemes were faced with problems. Their inability to pay sufficient attention to routine operations and maintenance of the dam infrastructure led to deterioration of dam embankments, canals and laterals. Another major problem was

their failure to ensure effective catchment area protection which resulted in siltation of the dams.

Also, because no water levies were paid by the farmers, they were not able to conduct minor repairs of dam infrastructure on their own and had to rely on MoFA which most often resulted in untimely repairs leading to the deterioration of the dam infrastructure. The irrigable land was under the total control of the landowners during both dry and rainy season making it difficult for the landless especially women to get access to land during dry season gardening. Women were not productively engaged in the dry season farming, they were only involved during harvesting periods where they helped their husbands' harvest the farm produces.

5.1.2 Present Trends

With regards to government policy of decentralization, diversification and privatization of the economy, government is divorcing itself from areas of activities that could otherwise be managed by the interested parties. Under LACOSREP I and II, management and ownership of the rehabilitated dams were transferred to the beneficiaries. It recognized the fact that for effective management and utilization of the facility, a specific target local group had to be charged with responsibility. The beneficiaries of the schemes were identified as gardeners, livestock owners and fishermen. These predominant groups constituted the WUA with the main aim to manage the scheme.

5.2 Stakeholders in the Management of Small Reservoirs in UER

The stakeholders in the management of the small reservoirs in the UER are the primary users and development agencies, including government organizations and institutions, and non-governmental organizations (NGOs). The primary users of the infrastructure are the members of the WUA.

5.2.1 Role of Stakeholders in the Management of Small Reservoirs in UER

The IDA of the MoFA is the key institution responsible for the design of irrigation schemes in the UER. International Fund for Agricultural Development (IFAD) funded LACOSREP I & II and IDA are the main implementers in the rehabilitation and construction of community dams in the region. NGOs such as, Action Aid, the Red Cross Organization, and the Catholic Missions are also involved in the provision of dams for both dry season vegetable farming and livestock watering in the study area. Table 5.2.1-1 gives the roles key organizations play in the management and provision of small reservoirs for irrigation in the UER.



Table 5.2.1-1: Role of Stakeholders in Management and Provision of Small Reservoirs

<i>Stakeholder</i>	<i>Role</i>	<i>Remarks</i>
Water Resources Commission (WRC)	Ensures sustainability of water resources and offer assistance to collaborating agencies to modify their policies towards WRM.	Assisted MoFA, in building capacities to help in the management of reservoir water.
MOFA/UER	Extension education on irrigation management and water conservation.	Takes place in all the nine reservoir sites. E.g. nursing and transplanting, furrow irrigation.
IFAD (LACOSREP I and II)	Rehabilitation and construction of dams and dugout for dry season gardening and livestock watering.	All the dams were rehabilitated under the project (1992-2006) except Anateem, Baare.
IDA	Design and supervise the construction of irrigation infrastructure (dams, canals, etc).	Design and supervised all the nine small reservoirs.
Department of Cooperatives and Community Development	Organizing WUAs into cooperative societies; training in group dynamics, financial management.	All the WUAs have been organized into cooperatives and were trained in financial management, group dynamics.
Catholic Secretariat / Missions	Fund construction of community dams.	Funded the construction of the Anateem dam.
WUAs	Management and maintenance of the reservoirs	WUAs in charge of management of all the dams visited.

Government and private sector organizations including NGOs e.g. Technoserve are involved in training and community sensitization activities in the reservoir water management. Also, local chiefs and other important personalities in the communities play important roles in the management of these reservoirs. They sometimes resolve WUA conflicts and ensure that rules and bye-laws established for successful management of the infrastructure are adhered to.

5.2.2 Strengths and Weaknesses of Stakeholders

Collaborations between stakeholders have been a major strength towards the attainment of increased livelihood and food security in the UER. A typical example is the collaboration between MoFA and DOC towards providing training for the WUAs on irrigation management and group dynamics. Another example is the collaboration between WRC and MoFA in helping build capacities towards integrated Water Resources Management (IWRM).

The lack of frequent supervision and inspection visits are weaknesses on the part of some stakeholders. They do not carry out feedback exercises to know the impact of their support activities on the irrigation infrastructure. For example, the DOC and the local NGOs do not visit the WUAs frequently to ascertain if the WUAs are practising what they have been taught. The TAs and TOs from the MoFA visit the WUAs only twice in a farming season which last for about five (5) months.

5.3 The Water Users Associations (WUAs)

The local unit of organization responsible for the management of the community dams is the Water Users' Association (WUA). The WUA is an organization that encompasses affiliated groups in the beneficiary community that have stakes in the dam infrastructure and services. In many of the communities, the WUA were made up of gardeners, fishermen and livestock owners.

Elected representatives of the user groups constitute the Damsite Management Committee (DMC), which is responsible for the management of the system. A typical DMC consists of a chairman, secretary, treasurer and sometimes an assistant treasurer, organizer and trustee. They are selected through voting and have 3 years tenure of office. Elections are preceded by nominations of names of members for approval, and voting is conducted if more than one person is nominated for a position. Women tend to hold less important positions like trustee and assistant treasurer (Ayariga, 2008).

5.4 The Management Functions of a WUA

The main functions of the associations include mobilizing community effort towards the maintenance of the dam and irrigation infrastructure. Typically, the most important maintenance activities carried out by user groups of dams include:

- Maintenance of the irrigation system (control structures, canals, laterals).
- Maintenance of dam infrastructure (dam wall, spill way, and reservoir).
- Grassing of dam embankment and bunds against erosion.
- Protection of the catchment area (grassing, tree planting) to control erosion.
- Protect crops from grazing animals.

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Other functions carried out by the WUAs are:

- Land allocation and water distribution
- Collection of water levies and funds mobilization
- Record Keeping
- Formulation and enforcement of bye-laws
- Conflict resolution

Work is carried out collectively with all members taking part. Some of the WUAs have developed maintenance cultures that require them to undertake periodic walkthrough inspections to ascertain the health of the irrigation systems and to inform themselves of the interventions required. Decisions on water distribution arrangements as well as the amount to levy for irrigation water for a particular season are jointly taken at a general meeting of the WUA.

5.5 Indicators and Benchmarks for Measuring the Performance of WUAs

5.5.1 Indicators for Measuring the Performance of WUAs

The following indicators are used for measuring the performance of WUAs.

- Irrigation Management Functions (*Management of irrigable area*)

This involves the control of irrigable area by WUA, equitable allocation of plots, ownership of plots by women and effective utilization of irrigable plots.

- Water Management Functions (*Water allocation policy of the WUA*)

The water management functions include efficiency of water distribution, existence of water usage regulations and maintenance of canals and laterals.

- **Agricultural Water Usage (*Crop production*)**

It takes into consideration cultivation of high value crops, the adoption of improved technologies, input usage and provision of marketing channels for the harvest.

- **Non-Irrigation Functions**

The non-irrigation functions are measured according to WUA member's conformity with bye-laws, effectiveness of executives, the level of democracy in decision making, conflict resolution ability, the existence and adequacy of bye-laws, fixing and collection of water levies, judicious usage of funds and the level of accountability of executives (Ayariga, 2008).

5.5.2 Performance Benchmarks of the WUAs

The standard by which the performance of the WUAs is measured is according to the degree to which they are executing their roles and responsibility according to the following:

- Equity in land and water distribution,
- Sustainability of the scheme, and
- Profitability and better livelihoods.

5.6 Reservoir Case Studies

This section presents the specific cases of the nine (9) reservoir sites visited. It focuses on the management impact of the WUAs with respect to Irrigation Management Functions (land allocation policy), Water Management Functions (water allocation policy), Agricultural Water Usage (Crop Production), as well as Formulation and Enforcement of Bye-Laws and Conflict Resolution.

5.6.1 Management of Irrigable Area

At all the dam sites visited except for Anateem, Bolga Soe and Bongo Central, where the irrigable lands were under the control of landowners during the dry season, the irrigable lands have been acquired by the WUAs during the dry season. The legal acquisitions of these lands were done by the District Assemblies through the preparation and endorsement of the Leases Agreement Documents of the Lands with the landowners and opinion leaders. The allocation of plots to members is not equal at Telania, Anateem, Nyangania and Dorongo. It depended on the performance of farmers during the previous seasons and adherence to the regulations and bye-laws of the association. The average plot sizes ranges from 0.01 to 0.07 ha depending on the total irrigable area. Refer to Appendix B for details.

At Bolga Soe and Bongo Central, the DMC locate the area for farming but the landowners give it out depending on ones need and ability to pay. In such cases, the total irrigable lands are not effectively utilized as a result of the frequent interferences from the landowners. The extent of dry season farming depends on the amount of

water in the reservoir at the end of the rainy season. Most farmers perform routine maintenance on canals and laterals but sometimes are supported by MoFA.

5.6.2 Water Management Functions

All the WUAs have water usage regulations indicating when and how long one can divert water to their fields. The opening and closing of the valves is done by a water bailiff appointed by the DMCs. The irrigable areas are divided into sections and each section is given water according to the schedule. Water is opened 1½ to 2 hours twice in a week at Telania, Doba, Dorongo, Bolga Soe and Bongo Central. At Nyangania, Anateem and Sumbrugu water is opened for members thrice in a week for 2 hours.

One main problem facing the WUA at Baare is the frequent illegal water abstraction resulting in less water available for downstream farmers. The WUA at this dam site records about four of such case each season. Degree of illegal water diversion to fields is minimal at the other dam sites because of the stringent penalty for defaulters. Defaulters are made to pay penalties and it can take any form ranging from loss of irrigable plot during the next season or a fine of GH¢ 1.0 or both.

The WUAs at Kassena-Nankana District comprising Doba, Nyangania and Telania pay GH¢ 5.00 (directive from the district WUA council) as water levy for a season. The others pay GH¢ 1.00 as water levy for one farming season. This amount is decided by the WUAs during a general meeting. The levies are used for the repairs and maintenance of broken down canals, laterals and leaking valves.

5.6.3 Crop Production

Crops grown in the dry season include tomato, pepper, okra, cabbage and leafy vegetables and during the rainy season especially tomatoes and leafy vegetables because of its high value. Crops grown at each reservoir site is shown in Appendix B. WUAs decide on the types of crops to be cultivated depending on the level of water in the reservoir at the end of the wet season. They grow millet, sorghum, rice and maize in the rainy season. They undertake cultivation from October/November to March/April.

Extension and technical officers from MoFA visit them twice every season and offer assistance to the farmers on improved methods of farming such as soil and land preparation, nursing and transplanting and on the management of the reservoir (refer to Appendix D3). Except at Telania, farmers receive subsidies on fertilizer allowing them to apply enough fertilizer unto their fields thereby increasing their yield. They Farmers at Doba sometimes acquire the fertilizers on hire-purchase.

WUAs at Baare, Sumbrugu and Bongo Central have Marketing Committees who provide market channels for the farmers to sell their produce. The advantage of this is that farmers get easy market for their produce lifting the burden of finding market for their produce. They sometimes get better income from such arrangements especially if it involves market women from Accra.

5.6.4 Formulation and Enforcement of Bye-Laws and Conflict Resolution

The WUAs have laws and regulations governing them. The department of Cooperatives helped in the formulation of the bye-laws. Most WUA members at Nyangania, Anateem, and Telania conform to the bye-laws by paying their water levies, attending meetings and communal labour. They also meet thrice each season to take decisions on fixing and collection of water levies during general meetings. The others meet twice each season. The levies collected are sometimes used to repair damaged canals, laterals and leaking valves when the need arise especially at Doba, Nyangania and Telania.

The WUAs at Baare, Telania and Dorongo are faced with conflicts between upstream and downstream users which results from illegal water abstraction. This makes less water available for downstream farmers. These WUAs have not been trained on conflict resolution and management and therefore, have not been able to resolve them. The WUA at Baare were able to resolve some conflicts with the help of the District Chief Executive and the chief. Defaulters are made to pay penalties and it can take any form ranging from loss of irrigable plot during the next season or a fine of GH¢ 1.0 or both. The WUAs at Nyangania, Anateem and Bolga Soe have been trained in conflict resolution and management and hence, are able to resolve most of their conflicts.

Database of the small reservoirs visited is at Appendix B.

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5.7 Impact of Management on Small Reservoirs for Dry Season Irrigation

5.7.1 Financial Mobilization by the WUAs

The WUAs have registered a tremendous increase in revenue mobilization over the past years. Funds are mobilized through the payment of water levies and penalty charges. They use some of the money to carryout repairs on the irrigation scheme. The amount of financial mobilization by some of the WUAs is at Appendix D. The level of financial mobilization by some of the WUAs is shown in Table 5.7-1.

Table 5.7-1: Level of Financial Mobilization by WUAs and their impact on Irrigation Infrastructure

WUA	Financial Mobilization	Remarks
Sumbrugu	Levy and penalty collections are not effectively done. Members are allocated plots before they pay levies. The executives are ineffective especially in the collection of dues. 55% of members pay levies regularly.	WUA do not repair broken structures on time due to lack of funds. The valves and dam wall are leaking leading to a reduction of water in the reservoir.
Bolga Soe	Executives are not active in discharging their duties such as ensuring members pay levies. About 70% of members do not pay levies.	Broken canal and laterals as a result of untimely repairs due to insufficient funds. Water is lost through leakages.
Doba	Members pay levies both in dry and wet season before allocation of land and is effective. 70% of members pay levies regularly. E.g. WUA registered a 482% increment in revenue mobilization between 2003 and 2004.	Timely repairs of broken infrastructure. WUA repaired broken canal and leaking outlet valve between June and September 2007.
Baare	Effective levy collection method. Payment of levy is a pre-requisite for	Timely repairs of canal and laterals. For example all minor

	land allocation. About 80% of members pay levies regularly.	repairs for the past four years have been done by the WUA.
Telania	Effective funds mobilization as the DMC ensures regular payment of levies and penalties by members.	WUA is able to do minor maintenance on canal and laterals as well as drop structures leading to efficient water delivery.
Bongo Central	Financial mobilization is not very effective because WUA does not have control over the irrigable land. The DMC is ineffective e.g. they fail to collect levies as well as penalties from defaulters. WUA registered 28% increment in revenue mobilization between 2003 and 2004.	Takes some time before repair works are done on broken canal and laterals. This led to the total collapse of the main canal in 2005.
Dorongo	Mobilization of funds is not encouraging. Members complained that the executives embezzle the funds and because of this, only a handful (about 30%) pay levies regularly.	The laterals and drop structures have broken down and have not been attended to for the past two years.

Without funds there can be no effective maintenance and repairs of the infrastructure as can be seen at Dorongo and Sumbrugu. Taking into account the number of farmers at some of the WUAs and the levies fixed per farmer, much more could have been generated than they are doing. Embezzlement of funds by some members of the DMCs is common and results to conflicts and non-payment of levies by some members. Poor book-keeping also makes it difficult to ascertain income earned by the WUAs. These weaken the financial base of the association and most often prevents effective maintenance and repairs of the infrastructure.

5.7.2 Maintenance

The need for maintenance was observed to be recognised and practised at most of the dams visited. The executives of the WUAs visited iterated some of the maintenance activities which take place from time to time to ensure the proper functioning of the scheme. The levies collected are used to undertake maintenance activities including mending of cracks in the concrete structures such as spillways, canals and laterals which most of the WUAs agreed were sufficient. Table 5.7-2 shows the nature of repairs/maintenance activities of the WUAs visited and their impact on the irrigation infrastructure based on field measurements, observations and inferences.

Table 5.7-2: Nature of repairs/maintenance and their impact on Irrigation Infrastructure

WUA	Nature of Repairs/Maintenance	Impact on Irrigation Infrastructure
Telania	Cleaning canal and laterals of weeds, filling of minor erosion gullies on embankment.	1. Increased conveyance of canal and laterals leading to effective water delivery 2. Increased embankment stability
Sumbrugu	Plant grass on bunds and dam walls, cleaning of canals	1. Reduce siltation 2. Effective water delivery
Bongo Central	Repairs on dam walls and canals, cleaning of canals and laterals of silt and thrash.	1. Reduced seepage and infiltration. Hence, more water for irrigation. 2. Increased conveyance of canals and laterals.
Doba	Canal, outlet valve and dam wall maintenance	1. Effective water delivery to fields. 2. Reduced water loss through seepage, leakage and infiltration.

The WUAs at Baare, Bongo Soe and Dorongo were not engaged in any form of maintenance activities. The canals and laterals at these dams were observed to be broken with weeds overgrown in them. The embankment walls were observed to be eroded. These lead to seepage and water wastage reducing the effectiveness of water delivery to the fields and volume of water in the reservoir for dry season irrigation. At these reservoir sites, the total irrigable areas were not fully utilized as a result of insufficient water.

Maintenance activities of the irrigation infrastructure were initially limited to dry season when gardening activities were at their peak. The WUAs at Nyangania, Anateem, Sumbrugu and Telania have now taken rainy season maintenance responsibilities. Some of the maintenance activities during the rainy season include:

- Canal maintenance through the removal of weeds whose roots can crack the lining in the main canals and laterals.
- Control of erosion on dam walls through the replanting of *vertiver* grasses.

5.7.3 Catchment Area Protection

The survey revealed that some of the catchment areas were properly protected with *vertiver* grass and in few cases *neam*, *acacia* and *Tectona grandis* (teak) which are drought resistant trees. Table 5.7-3 shows the conditions of the catchment areas of the dams visited.

Table 5.7-3: Condition of the Catchment Areas of Dams

Dam site	Condition of Catchment Area			
	Farming activities taking place	Protected with vertiver grass	Protected with tree cover e.g. <i>acacia</i> , <i>neam</i>	Not protected with grass and trees
Sumbrugu	x	√	X	x
Bolga Soe	√	x	X	√
Doba	√	x	X	x
Nyangania	x	√	√	x
Baare	x	√	X	x
Telania	x	x	√	x
Bongo Central	x	x	X	√
Dorongo	√	x	X	√
Anateem	X	√	√	x

√ = Existing phenomenon x = Non existing phenomenon

Catchment protection with *vertiver* grass, *acacia* and *neam* has reduced siltation making enough water available for dry season farming. Dam sites e.g. Doba and Dorongo without any form of catchment protection and with farming activities taking place along the catchment area experience severe siltation leading to reduction in reservoir water for dry season irrigation. Irrigable areas at these dam sites were not fully utilized because of unavailability of water.

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5.7.4 Plot Allocation/Irrigable Area Control

It was observed that in most of the reservoir sites that are effectively used, there is a fair representation of women. Women, in fact dominate in some areas such as Bongo Central and Nyangania. An important aspect of the landholding issue is the fact that there is no evidence of discrimination against women in the allocation of lands within the irrigable area at the reservoir sites visited. Table 5.7-4 shows the control and use of irrigable lands at the dam sites visited.

Table 5.7-4: Use and Control of Irrigable Lands at the Dam Sites

Dam Site	Control during rainy season	Remarks	Control during dry season	Remarks
Sumbrugu	Landowners	EU	WUA	EU
Bolga Soe	Landowners	EU	Landowners	PU
Doba	WUA	EU	WUA	EU
Nyangania	Landowners	EU	WUA	EU
Baare	Landowners	EU	WUA	PU
Telania	Landowners	EU	WUA	EU
Bongo Central	Landowners	EU	Landowners	EU
Dorongo	Landowners	PU	WUA	PU
Anateem	Landowners	EU	WUA	EU

EU=Effectively Utilized PU=Partially Utilized

Since most of the WUAs have control over the irrigable area during the dry season, members are able to get plots to cultivate during the dry season without any form of difficulty. This has reduced the perennial interference of landowners in the allocation

of irrigable land. The legal acquisition of these lands was done by the District Assemblies through the preparation and endorsement of the Leases Agreement Documents of the lands with the landowners and opinion leaders.

Even though the WUAs were in control of irrigable lands at Dorongo and Baare, the DMC were not active in discharging their duties leading to partial utilization of irrigable lands. Due to the fact that most of the landowners are members of the association and the large number of farmers at Bongo Central, the irrigable area was effectively utilized even though it was controlled by the landowners during the dry season.

It is important to note that the utilization of the irrigable area depends also on conditions other than who controls it during the dry season. These conditions may be the amount of water available for dry season farming, number of members of the association and the membership of landowners in the association.

5.7.5 Conflict Management and Resolution

There has been a noticeable improvement in the conflict management and resolution abilities of the WUAs. Conflict cases at most of the dam sites have reduced as a result of the training they received on conflict management (MoFA/IFAD, 2004). These conflicts would not have arisen if good communication skills were employed.

Table 5.7 -5 shows the type of conflict and resolution abilities of some of the WUAs.

Table 5.7 -5: Conflict Type and Resolution by some WUAs

WUA	No. of Conflict (2006-2008)	Conflict Type	Remarks
Bolga Soe	4	Upstream and downstream water users	WUA resolved three. Have now been able to resolve it permanently as a result of the conflict resolution training from DOC.
Baare	9	DMC and members on use of funds as well as upstream and downstream water users.	WUA was able to resolve five with the help of the DCE and the chief. The association has not received any form of conflict management training.
Doba	N/A	Upstream and downstream water users	Have been able to resolve the protracted upstream and downstream conflict by the help of DOC.
Nyangania and Anateem	0	None	WUA received conflict management from Technoserve and Catholic Mission (local NGOs) after the rehabilitation.
Telania	8	DMC and members on use of funds as well as upstream and downstream water users.	Because WUA has not received any conflict management training they were able to resolve only three.

N/A = Not available

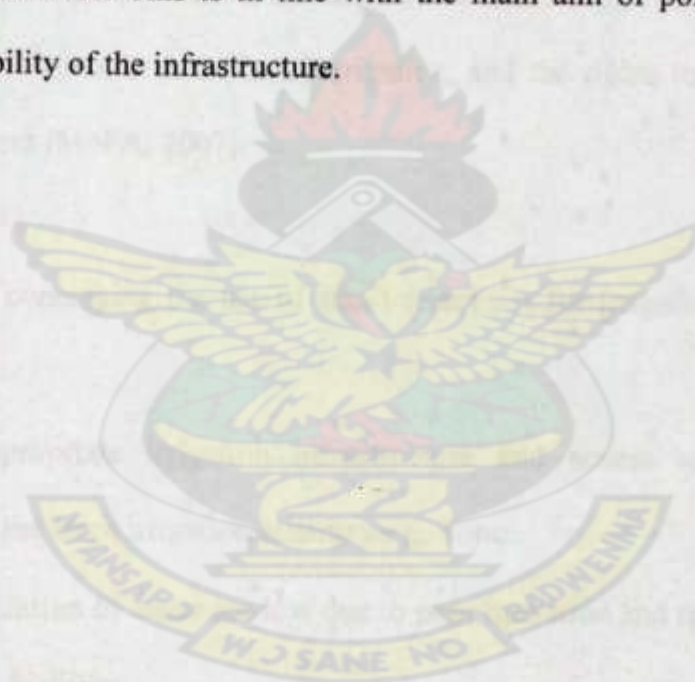
The protracted conflict between upstream and downstream farmers on water abstraction and use were resolved through the water delivery schedule which was prepared indicating when and how water was to be allocated to the different sections of the irrigable area. The downstream farmers now get enough water onto their fields.

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5.7.6 Growth of Participatory Culture

The survey also revealed a growth and appreciation of participatory approach within almost all the WUAs. This was evident in the smooth democratic change of leadership at all the dam sites visited between the periods 2001 to 2004 (MoFA/IFAD, 2004).

There has been a positive impact on the lives of WUAs who conducted their management functions effectively. Their household income has increased thereby increasing their standard of living. Most of the WUAs are aware of their role to maintain the infrastructure. This is in line with the main aim of policy makers to ensure the sustainability of the infrastructure.



5.8 Policy Impact on the Use of Small Reservoirs for Irrigation in UER

5.8.1 The Ghana Irrigation Policy

Currently, there is the draft irrigation policy which seeks to address issues concerning irrigation. The policy targets are for national food security and improved livelihood option.

The objective of the irrigation policy is to expand and improve the efficiency of irrigation to support agricultural development and growth. It will be pursued with principles of sustainability in operation and maintenance, and use of natural resources, equitable access by women to benefits of irrigation, and the rights to participate in irrigation management (MoFA, 2007).

Some of the issues concerning the use of small reservoirs for irrigation include the following:

- Lack of appropriate irrigation infrastructure and access to services as compared to the large irrigation schemes e.g. Tono.
- Rates of utilization of water are low due to poor operation and maintenance of the irrigation facilities.
- Lack of knowledge and skills in irrigation farming.
- Failure to take into consideration existing imbalances between men and women ownerships rights.
- Inadequate research and extension support to small scale irrigation farming.
- Limited stakeholder participation in the design and implementation of the scheme (MoFA, 2007).

The strategy for implementing this set of policy objectives is to transform Irrigation Development Authority (IDA) into a pro-active promoter of both public and private irrigation development with much more effective, functional links within the agriculture sector. The key collaborating agencies outside the Ministry of Agriculture are WRC, EPA and local government (ministry) but equally important are effective links with NGOs and private sector service providers (MoFA, 2007).

5.9 Policies influencing the use of the Small Reservoirs for Irrigation

5.9.1 Decentralisation and Subsidiarity

The structural adjustment policy to reduce the size and cost of government by devolving responsibilities and activities at the local level (i.e. Water User Associations) has great impact on these small reservoirs. Currently, the existence of a water user association has become a prerequisite for the handing over of irrigation schemes after completion of projects (construction and rehabilitation of small dams). The WUAs are responsible for the overall management of the small reservoirs with occasional support from MoFA and IDA.

5.9.2 Subsidies on Fertilizers

The policy of subsidies on fertilizers started from 1st June 2008 and ended in 31st December 2008 and was implemented by MoFA. The subsidies placed on fertilizers impacted positively on dry season irrigated farming because more farmers were able to apply fertilizers to their fields. Since there has been a decline in soil fertility in the

region for the past few years it has become very necessary to apply fertilizers during farming.

5.9.3 Extension and Technical Support

Extension and technical officers are provided by MoFA all year round to educate the farmers on good cropping practices as well as the general management of the reservoir. This is done in collaboration with the Department of Cooperatives (DOC) under the Ministry of Manpower, Youth and Employment. They are responsible for group formation and development of the WUAs into Farmers Based Organizations (FBOs).

5.9.4 Rehabilitation of broken down dams

In the case of severe damage caused by unexpected events, Government (MoFA-IDA) provides assistance to the extent of rehabilitation if it appears that the situation is out of control of the Water Users' Associations. Currently, most of the dams in the UER which were destroyed during 2007 floods are being rehabilitated. Seepages as well as damaged canals and laterals are also repaired by GIDA.

5.9.5 Socio-Economic Inclusion of Women

The current arrangements governing access to land and water resources inhibit long-term, productive engagement, particularly with respect to women. This policy is to remove the constraints and promote a balanced socio-economic engagement with land and water resources.

5.10 Impact of the Policies on the use of the Small Reservoirs for Irrigation

Government's policy to improve irrigation efficiency has the following impact on the use of small reservoirs for irrigation in the UER:

At all the dam sites visited the WUAs were responsible for the overall management of the reservoirs because of the sense of ownership attitude cultivated. Their management functions included irrigation management functions (land allocation policy), water management functions (water allocation policy), formulation and enforcement of bye-laws and conflict resolution and agricultural water usage. The WUAs are thus, involved in the decision making as far as the management of the reservoirs are concerned. The establishment of the WUAs is a way of collectively organizing the farmers to achieve a common goal. Members have a common mouth piece and hence their voices are heard at the district and regional levels through the WUA council e.g. Kassena Nankana District WUA council.

The farmers collect coupons from MoFA which enables them (farmers) to pay GH¢ 30.00 instead of GH¢ 60.00 for a bag of NPK fertilizer. This policy was being implemented at all the reservoir sites visited except Dorongo and Telania where farmers complained of not getting access to the subsidized fertilizer. Sometimes the farmers acquire the fertilizers on hire-purchase e.g. Doba. Table 5.10-1 shows the impact of fertilizer subsidy on farm yield.

Table 5.10-1: Impact of Fertilizer Subsidy

Name of WUA	Average plot size/ha	Farm yield (tomato), crate/plot		% increase in yield
		Before Fertilizer subsidy	After Fertilizer subsidy	
Sumbrugu	0.02	16	23	44
Bolga Soe	0.02	17	25	47
Bongo Central	0.02	16	24	50
Doba	0.03	24	32	33

The application of fertilizers to the fields enabled the farmers to get good harvest from their fields and also to make good use of the reservoir water. Farmers at Telania argued that with enough fertilizer application, twenty No. 4 sacks of pepper could be harvested for a season as compared to only five without enough fertilizer application.

All the WUAs visited received training and support from the extension and technical officers from IDA and MoFA as shown in Appendix D3. The extension and technical officers from IDA and MoFA visit them regularly and offer assistance to the farmers on improved methods of farming such as spacing between crops, pest control, transplanting and on the management of the reservoir. They advise them on the types of crops to be grown and good maintenance practises like the growing of grasses to prevent siltation of the dam through erosion. The field officers of the DOC helped the WUAs to enact their bye-laws, mobilise resources, group dynamics, open bank account and resolve conflicts, storage and post-harvest techniques, timely cropping and leadership roles. The WUA at all the dam sites visited receives all these forms of training from the DOC and is impacting positively as farmers yields have increased.

Rehabilitation of the dams has improved the livelihood and economic development of the beneficial communities. After rehabilitation, communities at Nyangania and Dorongo included dry season irrigation as an additional livelihood option. More people are now farming during the dry season as a result of expansion works during the rehabilitation process. Table 5.10-2 shows the rehabilitation periods for the dams.

Table 5.10-2: Date and Type of Rehabilitation of the Dams

Name of Dam	Date of Rehabilitation	Type of Rehabilitation	Impact on irrigation
Telania	Feb., 2004 - April, 2005	Dam wall and canal repairs	Continuation of dry season farming leading to effective utilization of irrigable land.
Nyangania	June, 2002 - May, 2006	Construction of Spillway, canal and laterals and dam expansion	Inclusion of dry season irrigation farming improving the livelihoods of people in the community.
Bongo Central	2002 – 2003	Construction of a second main canal, laterals	Increase in total irrigable land from 10 ha to 13 ha leading to an increase in area under cultivation.
Baare	2004 – 2006	Spillway and dam wall repairs	Continuation of dry season farming.
Dorongo	June, 2002 - Aug., 2003	Dam wall, main canal and laterals repairs	Inclusion of dry season irrigation farming improving the livelihoods of people in the community.

The perception that seems to prevail in all the reservoir sites visited is the fact that women are increasingly getting involved in dry season gardening activities as they consider this as a more secured source of livelihood support. There was no evidence of discrimination against women in the allocation of lands. Table 5.10-3 shows women involvement in dry season irrigation.

Table 5.10-3: Women Involvement in Dry Season Irrigation

Name of WUA	Plots ownership by Women (Men)		% increase/ Decrease	Executive Positions Held by Women (men)	
	2004	2008		2004	2008
Sumbrugu	2(20)	2(22)	0(10)	0(7)	0(7)
Bolga Soc	25(31)	32(35)	28(13)	1(3)	2(2)
Bongo Central	106(124)	174(146)	64(18)	1(8)	3(6)
Doba	29(75)	36(70)	24(-6)	1(6)	2(5)

Women are the most vulnerable members of society and the most responsibility-laden members of the family unit. The impact of this policy has been productive engagement of women in dry season irrigation which has led to increase in household income. This policy was implemented in conjunction with some local NGOs namely, Technoserve and Catholic Missions.

CHAPTER SIX

6.0 CONCLUSIONS AND RECOMMENDATIONS

6.1 Conclusions

- The collaborations between stakeholders have contributed positively towards the management of small reservoirs in the UER.
- Management impact has been the noticeable improvement in the conflict management and resolution abilities of the WUAs. Conflict cases at most of the dam sites e.g. Nyangania and Telania have reduced drastically as a result of the training support they received on conflict management.
- There has been increased revenue mobilization as a result of effective levy collection resulting in timely repairs of canals and laterals as observed in Doba.
- The subsidies on fertilizers and extension support given to the associations helped farmers practise improved methods of farming resulting in increase in farm yields as portrayed in Bongo Central where there was a 50 % increase in tomatoes yield.
- Women are increasingly getting involved in dry season gardening activities as they consider this as a more secured source of livelihood support. There is no discrimination against women in the allocation of lands within the irrigable area except at Sumbrugu.

6.2 Recommendations

- Stakeholders should be more proactive in discharging their duties especially when it comes to monitoring and supervision as well as in conducting feedback exercises to know the impact of their support activities.
- There should be a horizontal and vertical integration of all WUAs into District WUA councils (DWC). These councils would be the mouth-piece of WUAs to liaise with District Assemblies, the Regional Coordinating Council and other developmental partners to initiate programmes for the development of WUAs.
- The policy on subsidies on fertilizer should be maintained to enable farmers apply enough fertilizers unto their fields to increase yield.
- For this purpose, it is therefore recommended to increase the roles and responsibilities of the local bodies in the course of development and management of the small reservoirs as per the doctrine of decentralization. These should be coupled with the provision of support and training programmes for the WUAs to upgrade their capabilities.

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APPENDICES

APPENDIX A: Questionnaire ***Questionnaire 1 (first field visit)***

1. Personal Data

- 1.1. Name:.....
- 1.2. Locality/Community:.....
- 1.3. Sex: 1. ☐ M 2. ☐ F
- 1.4. Age = _____
- 1.5. Education level 1. ☐ basic 2. ☐ secondary/tech. 3. ☐ tertiary 4. ☐ none
- 1.6. Occupation of the respondent, 1. ☐ unemployed 2. ☐ trading 3. ☐ self employed
4. ☐ agriculture/ farming 5. ☐ others (specify)_____

2. Crop Yield

- 2.1. Farm size (ha)_____
- 2.2. What area under irrigation did you just harvested (ha)_____
- 2.3. What crop(s) did you harvest?_____
- 2.4. What is the current crop yield obtained from the above irrigated area? _____
- 2.5. What was the initial crop yield (kg) obtained from the irrigated area? _____
- 2.6. What brought about the change? _____
- 2.7. How many hectares of your cultivated land are accessible for irrigation? _____
- 2.8. Do you irrigate all of your irrigable land? 1. ☐ yes 2. ☐ no
- 2.9. If not, why? (Tick as many as apply)
 1. ☐ shortage of water 2. ☐ low productivity 3. ☐ poor quality of irrigation
 4. ☐ getting sufficient produce by rain feed agriculture
 5. ☐ poor maintenance 6. ☐ others (specify) _____

3. Irrigation Water Management Practice

- 3.1. What type of water delivery system is used from the source?
 1. ☐ motor pumps using electric power 2. ☐ motor pumps using diesel power
 3. ☐ diversion using gravity 4. ☐ others (specify) _____
- 3.2. Who operates water devices or structures and distribute water to farmers?
 1. ☐ IDA staff 2. ☐ Water bailiff (WUA) 3. ☐ Individual farmer
 4. ☐ others (specify) _____
- 3.3. Does the operator open/close the water gates according to schedule?
 1. ☐ yes 2. ☐ no
- 3.4. Is there a mechanism of water pricing for irrigation users?
 1. ☐ no, water is provided as a free service
 2. ☐ yes, water is provided by charge but does not vary with the quantity of water used
 3. ☐ irrigation water charge is based on the volume of water used
 4. ☐ others (specify) _____
- 3.5. If yes what is the price per year (or per ha)? _____

- 3.6. How many times do you produce annually by applying irrigation? _____
- 3.7. What are the main irrigated crops? _____
- 3.8. Why do you prefer to grow such crops? 1. ☐ better price 2. ☐ good production
3. ☐ easy to operate 4. ☐ high disease resistance 5. ☐ seeds availability
6. ☐ others (specify) _____
- 3.9. Do you use the reservoir water for other activities? 1. ☐ Yes 2. ☐ No
- 3.10. If yes, what are they?
1. ☐ Domestic 2. ☐ Livestock 3. ☐ Fish farming 4. ☐ House construction
5. ☐ others (specify) _____
- 3.11. Is there any problem during the application of irrigation water? 1. ☐ yes 2. ☐ no
- 3.12. If yes, what are they? (Rank them) 1. ☐ down stream conflict _____
2. ☐ shorter time allowed for irrigation water flow _____
3. ☐ water use administration problem _____ 4. ☐ lack of maintenance _____
5. ☐ lack of operational skill/training _____ 6. ☐ others _____
- 3.13. How many months of the year are you engaged in irrigation activities? _____
- 3.14. Are you able to apply as much water as you would like to your crops?
1. ☐ yes 2. ☐ no
- 3.15. What constraints affect you in using the scheme efficiently? (Put in order of importance) 1. ☐ lack of input financing _____ 2. ☐ shortage of labour _____
3. ☐ land acquisition problems _____
4. ☐ conflict in water utilization with users _____ 5. ☐ water shortage _____
6. ☐ lack of marketing for produce _____ 7. ☐ others _____
- 3.16. Do you have a programme for water distribution in scheme? 1. ☐ yes 2. ☐ no
- 3.17. Who is responsible for the coordination of water distribution to the fields?
1. ☐ anybody 2. ☐ Trained person 3. ☐ WUA
4. ☐ Individual farmers 5. ☐ others, specify _____

4. Maintenance Practices and Design Failures.

- 4.1. Who weed and/or desilt the canals and drains?
1. ☐ IDA staff 2. ☐ Farmers' association operator (WUA)
3. ☐ Individual farmers 4. ☐ others (specify) _____
- 4.2. Who repairs a crack in a canal bank? 1. ☐ individual farmer 2. ☐ Hired labourers
3. ☐ staff from the management (WUA) 4. ☐ others (specify) _____
- 4.3. Who inspects the canal systems? 1. ☐ the individual farmers
2. ☐ irrigation committee 3. ☐ IDA staff member 4. ☐ others, (specify) _____
- 4.4. Is there regular check on field channels before water is applied to plots?
1. ☐ Yes 2. ☐ No
- 4.5. In your view what do you think may be the causes to the failure of dam?
1. ☐ Poor design construction 2. ☐ Poor routine maintenance work
3. ☐ lack of field experts 4. ☐ lack of irrigation facilities for maintenance work
5. ☐ poor management of the scheme 6. ☐ others, (specify) _____
- 4.6. Is there a regular check up and repairs of damages on structures?
1. ☐ Yes 2. ☐ No

Questionnaire 2 (second field visit)

Name:.....
 Locality/Community:.....
 Date:.....

A. Local Capacity for Proper Management of Irrigation Infrastructure

1. What rules or regulations do you have guiding the running of the Association?

2. Who made the rules?

3. Have you found the rules useful? ☐ Yes ☐ No
4. If yes, in what ways have you found them useful?

5. Have members of your association received any training? ☐ Yes ☐ No
6. If yes, what was the nature of the training?
☐ Conflict management and resolution
☐ Book Keeping
☐ Group Dynamics
☐ Maintenance and repairs of irrigation infrastructure
☐ management of the scheme
☐ Irrigation farming (nursing and transplanting, etc)
☐ others, (specify).....
7. Who offered the training?

8. How do you raise funds for your activities?

9. Is the mode of funds mobilization effective? ☐ Yes ☐ No
10. Give reasons for the answer (9) above.

11. Have you received any support from any donor in you activities? ☐ Yes ☐ No
12. If yes, what was the nature of the support and how did you get the support?

.....

 13. How is decision taken in the association?

14. Do you have rules governing the use of the irrigation infrastructure?
 [] Yes [] No

15. List the main rules

16. What sanctions do you impose for defaulters?

17. Which body or group played a role in the formulation of the rules and what role did they play?

B. Policy Implementation

18. Do farmers receive subsidy on fertilizer? [] Yes [] No

19. If yes, in what form does it take?

20. What is the impact of the subsidy on farm yield?

21. What has been the impact of the Socio-Economic Inclusion of women?

Table 4.2: Database of Reservoirs

Description	TELANIA	ANATEEM	BAARE	BONGO CENTRAL
Irrigation infrastructure type	Pipe and lined canals and laterals	Pipe and lined laterals and canals	Pipe and lined laterals and canals	Pipe and lined laterals
Irrigation Method	Furrow	Furrow	Furrow	Furrow
WUA membership (Total/Female)	220/80	26/10	107/25	320/174
WUA executive (Total/Female)	7/3	7/3	7/3	9/3 (have two extra trustees)
Water Uses in dry season	Irrigation, Livestock, Fishing	Irrigation, Livestock	Irrigation, Livestock	Irrigation, Livestock, Fishing
Type of crops grown	Tomato, Pepper, Vegetables	Tomato, Vegetables	Tomato, Okra, Vegetables	Lettuce, Tomato, Onion, Okra, Cabbage, Pepper, Vegetables
FSL Surface Area (ha)	16	N/A	14.2	N/A
Total Irrigable Area (ha)	10	7	7.5	13
Average plot size/farmer (ha)	0.01	0.02	0.04	0.02
Operational Rule	1. Domestic 2. Livestock 3. Irrigation	1. Domestic 2. Livestock 3. Irrigation	1. Domestic 2. Livestock 3. Irrigation	1. Domestic 2. Livestock 3. Irrigation
Problems	- Siltation - Water shortage	Water shortage	- Water shortage - Nematode infestation	- Cattle grazing - Siltation - Pest and disease infestations

Description	NYANGANIA	SUMBRUGU	BOLGA SOE	DORONGO	DOBA
Irrigation infrastructure Type	Lined canals and laterals, pipeline	Lined canals and laterals	Lined canals and laterals	Lined canals	Pipeline, Lined canals and laterals
Irrigation Method	Furrow	Furrow	Furrow	Furrow	Furrow
WUA membership (Total/Female)	369/113	24/2	67/32	150/47	106/36
WUA executive (Total/Female)	7/2	7/0	4/2	7/3	7/2
Water Uses in dry Season	Irrigation, Livestock	Irrigation, Livestock	Irrigation, Livestock	Irrigation, Livestock	Livestock, Irrigation
Type of crops grown	Tomato, Vegetables, Pepper	Tomato, Onion, okra Vegetables, Pepper	Pepper, Tomato, Vegetables	Tomato, Vegetables	Tomato, Onion, okra, Vegetables, Pepper
FSL Surface Area (ha)	15.5	5.2	8.8	21.0	6.2
Total Irrigable Area (ha)	10	3.5	N/A	11	N/A
Average plot size/farmer (ha)	0.03	0.02	0.02	0.07	0.03
Operational Rule	1. Domestic 2. Livestock 3. Irrigation	1. Domestic 2. Livestock 3. Irrigation	1. Domestic 2. Livestock 3. Irrigation	1. Livestock 2. Irrigation	1. Livestock 2. Irrigation
Problems	Siltation	- Siltation - Animal grazing - Leakage in valve and dam wall	- Nematode infestation - Illegal water abstraction	Siltation	- Siltation - Shortage of water

N/A: Not Available

APPENDIX C: Interview/Talk

1. September 22, 2008 Mr. Aaron Aduna White Volta Basin Officer-WRC, Bolga Cell: 0242074137 Tell: 072 23391 Email: aaronaduna@yahoo.com	2. September 23, 2008 Mr. Opoku Boateng M & E officer (ICOUR-Tono)
3. September 23, 2008 Mr. Thomas Sumbu Deputy Managing Director-ICOUR, Tono.	4. September 24, 2008 Mr. Prince Seidu Engineer-GIDA, Bolga Cell: 0243771017/0275753700
5. September 24, 2008 Mr. Yaw Boabeng Director Lands Commission, Bolga	6. September 24, 2008 Mr. Raymond Moolba Director: UE Regional House of Chiefs, Bolga.
7. September 24, 2008 Mr. J. E. Andanya Director: CBRDP	8. September 24, 2008 Mr. Francis Derry Director of MoFA, Bolga
9. September 24, 2008 Alhaji A. R. Z. Salifu Ag. Regional Director, MoFA-Bolga	10. September 24, 2008 Mr. Boakye Engineer, MoFA-Bolga Cell: 0244216918/0208337978
11. September 25, 2008 Mr. Nathaniel Alaba PAGEV Project Technical Officer Cell: 0244547694	12. September 25, 2008 Mr. Aaron Aduna White Volta Basin Officer, WRC- Bolga Tel: 072 23391 Email: aaronaduna@yahoo.com
13. September 25, 2008 Mr. Krwanson Rural Aid Cell: 0249194816 Email: Kncrankson@yahoo.co.uk	14. September 25, 2008 Mr. Aaron Aduna White Volta Basin Officer, WRC- Bolga Cell: 0242074137 Tell: 072 23391 Email: aaronaduna@yahoo.com
15. September 25, 2008 Mr. Aaron Aduna White Volta Basin Officer-WRC, Bolga Cell: 0242074137 Tell: 072 23391 Email: aaronaduna@yahoo.com	16. January 06, 2009 Alhaji A. R. Z. Salifu Ag. Regional Director, MoFA- Bolga
17. January 06, 2009 Mr. Boakye Engineer, MoFA-Bolga Cell: 0244216918/0208337978	18. January 06, 2009 Clement Regional Officer, Dept. of Cooperatives. Cell: 0240383612

APPENDIX D: Financial Mobilization and Training Support

Appendix D1: Revenue mobilized and deposited in bank from 2002 to 2004

Name of WUA	Bank Account No.	March 2003 (GH¢)	April 2004 (GH¢)	Percentage Increase (%)
Sumbrugu	ADB-5768283011	74.96	74.96	0
Bolga Soe	ADB-5775165008	25.00	41.50	66
Bongo Central	ADB-5766630016	93.47	119.87	28
Doba	NRB 23-048	22.70	132.20	482

Appendix D2: Bank Savings as at May 2006.

Name of WUA	Bank Account No.	Bank Savings Balance (GH¢)
Sumbrugu	ADB-5768283011	875.91
Bolga Soe	ADB-5775165008	41.50
Bongo Central	ADB-5766630016	69.87
Dorongo	ADB-5768502015	175.16
Doba	NAARA- 23-048	59.59
Telania	NAARA-27-2698	3,42.92
Nyangania	NAARA-8-056	69.12

Appendix D3: Extension and Training Support given to WUAs.

Name of WUA	Extension Support	Training Support
Sumbrugu	Pest Control; Furrow Irrigation; Crop Spacing; Nursing and Transplanting	Post-Harvest Technique; Bank Account
Bolga Soe	Furrow Irrigation; Crop Spacing; Nursing and Transplanting	Conflict management; Bank Account; Group Dynamics; Post-Harvest Technique
Bongo Central	Furrow Irrigation; Crop Spacing; Nursing and Transplanting; Pest Control	Bank Account, Group Dynamics
Doba	Pest Control; Furrow Irrigation; Crop Spacing; Nursing and Transplanting	Conflict management; Bank Account, Group Dynamics
Nyangania	Pest Control; Furrow Irrigation; Crop Spacing; Nursing and Transplanting	Conflict management; Book Keeping; Post-Harvest Technique; Group Dynamics; Bank Account
Telania	Crop Spacing; Nursing and Transplanting; Furrow Irrigation	Conflict management; Book Keeping; Bank Account
Dorongo	Pest Control; Crop Spacing; Nursing and Transplanting	Bank Account , Group Dynamics
Baare	Pest Control; Crop Spacing; Nursing and Transplanting	Bank Account, Group Dynamics
Anateem	Furrow Irrigation; Crop Spacing; Nursing and Transplanting	Bank Account; Conflict management; Book Keeping, Group Dynamics