Kwame Nkrumah University of Science and Technology

College of Engineering

Department of Civil Engineering

ENHANCING COOPERATION IN WATER RESOURCES MANAGEMENT WITHIN COMMUNITIES IN THE BLACK VOLTA BASIN

Charles Gyamfi

MSc. Thesis

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ENHANCING COOPERATION IN WATER RESOURCES MANAGEMENT WITHIN COMMUNITIES IN THE BLACK VOLTA BASIN

By

Charles Gyamfi, BSc (Hons.)

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In

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CERTIFICATION

I hereby declare that this thesis is my own work towards the Master of Science (MSc) degree in Water Resources Engineering and Management 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.

Charles Gyamfi	……...	……
(PG 4777310)	Signature	Date

Certified by:

Prof. S.N. Odai	……..	……
(Supervisor)	Signature	Date

Dr. G. K. Anornu	……..	……
(Supervisor)	Signature	Date

Mr. F.O. Annor	……	……
(Supervisor)	Signature	Date

Prof. M. Salifu	……	……
(Head of Department)	Signature	Date

DEDICATION

To God Almighty

&

My parents Mr. Sylvester Gyamfi and Mrs Florence Gyamfi as well as siblings;

Constance, Alphonse, Doris, Patience and lovely kid Sister Angela

ABSTRACT

This study focused on the Black Volta River Basin which is one of the major sub-basins of the Volta River Basin. The semiarid and sub-humid nature of the regions within which the basin is located coupled with high population growth rate and climate change has resulted in a lot of pressure being put on water resources. These challenges faced within the Black Volta River Basin are prompting increased focus on water conflict prevention and management by way of enhancing cooperation within communities in the Basin. The research sought to look into how water resources within five communities in the Black Volta Basin of Ghana are being managed to ensure cooperation among all users. This led to the identification of the different water users and consequently, the identification of the potential conflict scenarios. The dominant water related livelihood strategy is crop and livestock production with 62% of respondents engaged in this type of livelihood strategy. By way of enhancing cooperation the traditional system of water management where traditional leaders (chiefs and Tindana) were seen to be custodians of water and land resources were upheld. The emergences of potential conflicts were tackled mostly by the chiefs in consultation with the community. It was observed that traditional management system was one of the unique strengths of community level water resource management in the study areas. This suggests that the mobilization of local institutions and experiences is a key strategy in local level water resource management. Rules and regulations governing the use of water for domestic purposes were widely known and strictly observed as compared to that on livestock watering and irrigation. The potential parties of conflict identified were mainly farmers and livestock owners. From the findings, the communities have adopted series of interventions that are geared towards cooperation and consequently to curb arising conflicts regarding the use of water resources. Among such interventions are the use of the priority of water use doctrine, water allocation principle and the principle of negotiation.

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LIST OF ABBREVIATIONS AND ACRONYMS

BVB	Black Volta Basin
DWST	District Water and Sanitation Team
EPA	Environmental Protection Agency
FAO	Food and Agriculture Organisation
FGD	Focus Group Discussion
GEF	Global Environment Facility
GIDA	Ghana Irrigation Development Authority
GLOWA	GlobalerWandel des Wasserkreislaufes (Global Change and Hydrologic Cycle)
GLSS 5	Ghana Living Standard Survey Round 5
GSS	Ghana Statistical Service
GWP	Global Water Partnership
ICWE	International Conference on Water and Environment
IK	Indigenous Knowledge
IUCN	International Union for Conservation of Nature
IWRM	Integrated Water Resources Management
KS	Knowledge Systems
MoFA	Ministry of Food and Agriculture
MWRWH	Ministry of Water Resources, Works and Housing
NGO	Non Governmental Organisation
PAGEV	Project for Improvement of Water Governance in the Volta Basin
PRA	Participatory Rural Appraisal
UN	United Nations
UNCED	United Nations Conference on Environment and Development
UNDP	United Nations Development Programme
UNEP	United Nations Environmental Programme

UWR	Upper West Region
VBA	Volta Basin Authority
VBTC	Volta Basin Technical Committee
WATSAN	Water and Sanitation Committee
WDR	World Development Report
WHO	World Health Organisation
WRC	Water Resources Commission
WUA	Water Users Association

1. INTRODUCTION

1.1 Background

Freshwater scarcity related to both quantity and quality is on the ascendency globally. The main determinant of this scarcity is the increasing water demand by a steadily growing population (Huang *et al*., 2010). Currently, world population stands at about 7 billion, and it is projected to be 8.3 billion by 2025. According to WHO (2012), 2.5 billion people of the world population lack access to adequate sanitary services, one billion people are without access to clean drinking water, and at least one billion people are undernourished. However, Target 10 of Goal 7 of the Millennium Development Goals seeks to "Halve by 2015 the proportion of people without sustainable access to safe drinking water and sanitation" (UN, 2000). This has caused many to suggest that a new paradigm for water planning must be developed and implemented (Biswas, 2001; Gleick, 2000). More importantly, is the fact that issues of water are now perceived to be of national and regional security risks (Chou *et al*., 1997). As water resources diminish due to population growth, pollution and over exploitation, the competition for water also exacerbates (Huang *et al*., 2010) which is seen as a potential source of conflict (Carius *et al*., 2004; UNDP, 2006). According to Carius *et al*. (2004) water related conflicts result mainly due to quantity, quality and timing issues. The issue of water conflict is aggravating in arid and semi-arid regions where water scarcity impedes social and economic development and this is linked to the prevalence of poverty, hunger and diseases (Falkenmark, 1989; Gleick, 1998). Again, problems related to the supply of freshwater resources, and more in particular to safe drinking water, cannot be addressed properly without recognising the interrelation between multiple functions and uses of water. Water resources are used for human consumption, for sanitation, washing, bathing and cultural or religious

rituals, and for economic purposes, such as agriculture, livestock, industry, tourism, and transportation. Water resources are also considered to be an integral part of the ecosystem, for wetlands, coastal areas and mangroves (Molen and Hildering, 2005). Notwithstanding the many threats posed by the looming water scarcity, it is also acknowledged as a means for cooperation.

The situation is not different when it comes to the water resources of the Volta Basin and specifically the Black Volta subbasin. Due to the competing uses of the water resources within the basin, there have been calls to ensure cooperation among the various water users so as to prevent the emergence of conflict.

1.2 Problem Statement

The riparian countries of the Volta Basin are acknowledged as some of the poorest in Africa with predominant economic activities in the basin being agriculture and animal husbandry (Andah, 2005). These sources of livelihood are centered mainly on the resources availability of the basin. However, due to high temporal and spatial variability in rainfall, prolonged dry season of 7 months, global environmental changes and population growth, there is serious pressure on the water resources with consequences for many of the rural poor in the basin. The currently high annual population growth rate of 2.5 % (Andah *et al.*, 2003) in the basin will lead to significant increase in water demand, particularly, for crops and livestock production in the near future. The ongoing global climate change puts further constraint on the already limited water resources in the basin. There is extensive migration and overexploitation of the natural resource base in the basin due to poverty. Increasing population also further worsens the issue of water in the basin (Van De Giesen *et al*.,

2001). Whether there is enough water among the various competing users such as farming, drinking and livestock is an issue that has to be looked into not neglecting the developmental needs of the inhabitants who depend on this resource.

1.3 Justification

Considering the high degree of poverty of the people living in the Black Volta Basin, measures need to be taken to ensure that there is improvement in their livelihoods. This can be achieved if the available water resources are shared among the various competing users. This therefore calls for the effective and efficient management of the resources base. Any attempts to ensure effective water management therefore need to encompass local knowledge systems in order to develop an IWRM strategy and to avoid water-related conflicts. Since conflicts arise largely at local levels (Carius *et al*., 2004) there is the need to understand how local knowledge is used to address water management needs and how indigenous knowledge can enhance cooperation in the use and management of water resources.

1.4 Research Questions

The key questions addressed in this research work are:

- What water related livelihood strategies exist in the study communities?
- What are the potential sources of water related conflicts and what mechanisms exist for their resolution?
- What traditional water management practices exist and how do these practices enhance cooperation?

1.5 Research Objectives

The main objective of the study is to improve water resources management within communities in the Black Volta basin.

To achieve this main objective, the following specific objectives must be answered. That is, to:

i. Examine water resources related livelihood strategies within selected communities.
ii. Identify potential sources of water resources conflict and the mechanism for their resolution.
iii. Assess traditional water management practices and how these practices enhance cooperation.

1.6 Limitations of the Study

The study is limited to the extent that it is based on only five selected communities in the Basin. This makes it difficult to generalize the findings though there could be some useful lessons. Another setback worth mentioning was language barrier. Only few of the respondents could communicate in English and hence interpreters were used throughout the study especially during the household interviews. Notwithstanding these challenges, the researcher was able to make maximum use of the allotted time in collating the needed information for this study.

1.7 Scope of Work

The research was conducted in five communities within the Upper West region of Ghana. These communities were selected from three different districts namely; Lawra-Nandom, Nadowli and Wa West. Within these districts, communities lying

close to the Black Volta River and where vibrant socio-economic activities occurred were considered for the study.

1.8 Structure and Organization of Report

The report is presented in six chapters. Chapter one covers the introductory part of the report which includes the background, research questions, objectives of the study, limitations to the research work as well as the structure of the report. Chapter two takes a comprehensive look at literature. Description of the study area is carried out in chapter three. The fourth chapter outlines the methodology and tools used for the data collection and analysis. The results and findings of the study are presented in chapter five and the sixth chapter gives the summary of the conclusions and recommendations of the study.

2. LITERATURE REVIEW

2.1 Definition of Key Concepts

Most of the key concepts that are used in this study have varying definitions and for that matter the need to explain these concepts with respect to this study. The varying key concepts are namely; Indigenous Water Management Practices, Integrated Water Resources Management and livelihoods.

2.1.1 Indigenous Knowledge Systems (IKS)

Knowledge may be defined as 'the state or fact of knowing something with familiarity, awareness or understanding gained through experience or association' (Merriam-Webster, 2011). According to Roling and Seegers (1991), Knowledge Systems (KS) are "a set of actors, networks or organisations which are expected to work to support knowledge processes that improve the correspondence between knowledge and environment, and the control, provided through technology use, in a given domain of human activity".

Indigenous knowledge also refers to local knowledge that is unique to a given culture or society and which has evolved through their efforts (Warren *et al.,* 1995). In contrast to the above definition is that proposed by Van der Bleik and van Veldhuizen (1993) which sees IK as ideas, practices, experience and information that is either generated locally or is generated elsewhere but has been transformed by local people and incorporated into the local way of life. Considering the fact that livelihoods of the rural poor depend on indigenous knowledge (World Bank, 2000), it is key not to overlook the potential that is inherent in local experiences and practices in the management of natural resources.

With respect to this study, the definition of IK given by Van der Bleik and van Veldhuizen (1993) is used. According to them, IK is defined as ideas, practices, experience and information that is either generated locally or is generated elsewhere but has been transformed by local people and incorporated into the local way of life.

2.1.2 Integrated Water Resources Management

Water is critical, but often overlooked element in sustainable development. For effective and long lasting solutions to water problems, a new paradigm to water governance and management is required. Such a new paradigm is encapsulated in IWRM concept (GWP, 2000). The Global water partnership defines IWRM as a process that favours the co-ordinated management and development of water resources for the purposes of maximising the resultant economic and social welfare in an equitable manner without compromising the sustainability of vital eco-systems (GWP, 2000). According to Jasper (2003), the definition of IWRM above lacks operational credibility. In an attempt to provide an operation definition for IWRM, Jasper (2003), defined IWRM as the management of surface and subsurface water in qualitative, quantitative and environmental sense from a multi-disciplinary and participatory perspective and focussed on the needs and requirements of the society at large with regard to water for now and in the future. IWRM explicitly challenges conventional, fractional water development and management systems and places emphasis on integrated approach with more coordinated decision making across sectors and scales. As a process of change which seeks to shift water development and management systems from their currently unsustainable forms, IWRM has no fixed beginnings and will probably never end. Since global economy and society are dynamic and the natural environment is also subject to change, IWRM strategies

therefore, need to be responsive to change and be capable of adapting to new economic, social and environmental conditions and to changing human values. In line with this study, the GWP definition of IWRM is adopted.

2.1.3 Livelihood

Livelihood simply means the sources of sustenance. The Merriam Webster's dictionary defines livelihood as a means of support or subsistence. In UN's efforts to develop a working definition for livelihood, used the definition put forward by Chambers and Conway. According to Chambers and Conway (1991), "livelihood comprises the capabilities, assets (including both material and social resources) and activities required for a means of living." This refers to strategies that are put in place to ensure human sustenance. Among rural communities, these strategies mainly include subsistence farming, fishing and trading that have been practiced over years. As said by Chamber and Conway (1991), these livelihood strategies have coped and recovered from stress and shocks that have occurred over these years. In all the definitions above, one thing is paramount; to ensure human sustenance and hence the definition put forward by Chambers and Conway is adopted in this study.

2.2 Ghana's Water Reforms

2.2.1 From Customary to Statutory Water Rights

Communities prior to colonization have evolved means of governing natural resources particularly in the use of water. The various uses of water prior to colonization included human consumption, agriculture, transportation and environmental protection. With the onset of colonialism, different dimensions of water use came into being namely hydropower production and irrigation. Water in customary law is

considered a Public good (IUCN, 2003) irrespective of the form it takes (i.e. sea, ponds, rivers, etc) and for that matter not subjected to individual appropriation (Sarpong, undated). Ownership of water, under customary law, is vested in stools, communities and families. It is however, uncertain as to whether customary law treats ground water as part of land so as to render it under the private possession of the land owner. The evolution of customary rules has ensured the sustainable and equitable use of water resources. Typical of this customary rule is a common location for fetching water from a stream or river that runs through two neighbouring communities (FAO, 2008). It is also acknowledged that the use of water resources should not be in a manner as to deprive others from enjoying the same resource. Upon the enactment of the water resources Act, Act 522 of 1996, the Water Resources Commission was established. This Act vested the ownership of water resources in the President to hold it in trust and on behalf of the people of Ghana

2.3 Water Resources Commission

The Water resources commission was established by an Act of Parliament (Act522) in 1996 and started operations in 1998 (MWRWH, 1998). The main aim for establishing WRC was for it to serve as an umbrella institution for national water policy in order to coordinate different government agencies and their different interests and approaches. In other words, the WRC is to ensure the implementation of IWRM. The commission also has regulation which forms the basis for the allocation of water-use rights to institutions and users. It is imperative however; to mention that the commission has encountered difficulties as far as bringing on board stakeholders are concerned. In the light of the difficulties, international donors have also been of immense help through the introduction of water user associations (WUAs) (Van Edig *et al*., 2003).

Regardless of these; little or no consideration has been given to the integration of indigenous management practices into water management reforms. The mandate of the commission among other things includes;

- Coordinate affairs within the water sector and ensure the exchange of data between relevant institutions.
- Work towards the integration of all stakeholders within the water sector whiles respecting tradition, norms and customs.
- Guarantee access to safe drinking water and sanitation.
- Supervise water quality.

2.4 Relevance of Indigenous Knowledge and Practices

Indigenous knowledge and practices is now a key to ensuring sustainable development (World Bank, 1998; WDR, 1999) and for that matter developmental processes should incorporate concepts of local knowledge. There is clear evidence where project interventions have failed (World Bank, 1998) to achieve their intended purposes due to the fact that no recognition was given to indigenous local knowledge. However, it is imperative to scrutinize indigenous knowledge and practices for their appropriateness before they are adopted in the developmental process.

2.5 Indigenous Water Management Practices

The management of water and other natural resources were well rooted in indigenous knowledge during the pre-colonial era. There were assigned implements solely for the purposes of fetching water. This was done to ensure that there is enough water for everyone. For the purposes of preventing water pollution, the drinking part of the river was located upstream with the other activities being downstream (IUCN, 2003).

Religious and customary beliefs served as potent instruments for ensuring compliance with customary rules on water usage. In certain jurisdictions in Ghana, farming close to the river banks and on certain days of the week is prohibited. Same could be said of Burkina Faso where the Mossi treated their water resources as sacred, and maintained certain regulations which were implemented by earth priests and chiefs to protect and to maintain the integrity of water resources. Contravening such rules are often met with a fine or punishment usually death from the deity in the community (Sarpong, undated). Although indigenous knowledge played a vital role in the management of water resources the advent of colonization brought about a reduction in the way and manner these knowledge were upheld. The observance of indigenous knowledge and practices are now mostly confined to rural communities. In furtherance, the authority and powers exercised by chiefs have given way to laws and ordinances.

2.6 Water and Rural Livelihood

Water is one of the critical natural resources in life. It constitutes an essential element in rural livelihoods because of its contribution to food security and income generation from rain fed and irrigated crop production, aquaculture and livestock. Most rural livelihoods are reliant on natural resource base to a greater extent (Chambers and Conway, 1992). Thus water plays a major role in ensuring food security and sustaining livelihoods, especially in rural communities. Hence, for most rural people, the ability to maintain food security depends on the effectiveness of the livelihood strategies. As a result, food production and supply in Sub-Saharan Africa countries is closely linked to utilisation and access to water, since water shortages are seriously constraining increased food production (Narendra *et al*., 1996). In their study, Narendra *et al*., (1996), found out that lack of adequate water resources greatly

reduces the gross domestic production, and thus leads to poverty and decline in quality of livelihoods. Water availability is closely linked to human welfare and health. It affects nutritional status and quantity of drinking water, especially for the poor. These problems are more keenly felt among the poor households and in the agricultural subsistence economy. Most of Africa's poor, just as in Ghana, live in the rural areas. In such a situation, making rural households secured with respect to food, water and energy is key to reducing poverty (Narendra *et al*., 1996). At the second World Water Forum held in 2002, it was recognized that water crisis is mainly a crisis of governance (Arriens and Alejandrino, 2004). Delegates at the Second World Water Forum pledged to institute reforms in the water sector to improve governance. Most African countries, including Ghana recognize that water resources must be used wisely to improve human welfare, achieve economic growth and therefore reduce poverty. In the Ministerial Declaration of the International Conference on Freshwater held in Bonn, it was recognised that "combating poverty is the main challenge for achieving equitable and sustainable development and water plays a vital role in relation to human health, livelihoods, economic growth as well as sustaining ecosystems." Ndalawha (2002), recognises that water scarcity is an important environmental constraint to development. However, these water reforms which claim to be objectively focused at improving livelihoods among other things, have failed to address the poverty issue at the grassroots level. According to van der Hoeck (2001), unless there is new action to recognize both the roles water plays in rural livelihoods and people's capacity to manage their water sustainably and with social justice; water scarcity will continue to be a threat to development. It is also important to realize that when people have water dependent livelihood strategies, they create relationships of cooperation and control in order to acquire and manage water systems. How

livelihoods survive under scarcity is related to how people understand water scarcity, organize social action to remedy it, and act to defend their rights. Improved rural water governance is a powerful tool to diversify livelihoods and reduce vulnerability, especially for small farm holders. It is well established that investments in water resources management and the delivery of water services are central to poverty reduction. Interventions in the management of water resources or delivery of water services could further entrench inequalities and reduce already lamentable access of the poor to these resources unless they have an explicit poverty objective (Reba, 2003). With water scarcity and increasing competition for water, there has risen the need for more effective and adaptive governance through better stakeholder participation, improved policies and institutional mechanisms for managing river basin water resources. Effective stakeholder participation in water resources management calls for a strategy that better involves the water user at the lowest appropriate (local) level; a system that contributes to poverty reduction through improved and sustainable water resources management. This would involve empowering the local communities in natural resources management and consultation with communities on their needs and the appropriate mechanisms they have to address those needs in water issues. One of the strategies proposed by Narendra *et al*., (1996), as a way of improving water resources in order to lessen the impact of future water scarcity is the consideration of customary law and models of water governance.

2.7 Overview of Water Governance in the Volta Basin

There has been little coordinated transboundary effort in the basin until the establishment of the Volta Basin Authority (VBA) in 2006. Hitherto, the riparian countries acted independently in harnessing the river. The looming signs of conflict in the basin led research institutions and agencies such as GLOWA-Volta, Green Cross International, UNEP and the World Bank to undertake initiatives geared towards sustainability and governance (Lautze *et al.,* 2005). As a result, the Volta Basin Technical Committee (VBTC) came into being in November 2004. The riparian countries then agreed to sign an agreement which eventually led to the establishment of the VBA in July 2006.

At the sub-basin level, international research activities are underway. Typical example of these research works is the Project for Improvement of Water Governance in the Volta Basin (PAGEV) (Ampomah *et al.*, 2008) in the White Volta Basin of Ghana (Nakanbé basin on the Burkinabé side). The PAGEV Project is being implemented by the International Union for Conservation of Nature (IUCN). The PAGEV Project is working on an agreement between the WRC and the Direction Generale de Ressource Hydraulique, the national water authorities of Ghana and Burkina Faso, respectively and is therefore a cross border initiative. Mention could also be made of Global Environmental Facility (GEF-UNEP) research that was carried out in 2002 to diagnose the problems related to transboundary water resources in the Volta basin.

Clearly, the development process has been intense with little or no acknowledgement given to the role traditional leadership and traditional practices play in the management process. Unfortunately, water resources at the local level are being

expropriated and controlled in a top-down approach by agencies such as the WRC. This style of aggressive institutional behaviour is not conducive for collaboration. It is therefore important to take into accounts traditional values when considering water governance in the Basin.

2.8 The Principles of IWRM (Dublin Principles)

The concept of IWRM is linked to the principles adopted by the Dublin Conference on Water and the Environment (ICWE, 1992) and Agenda 21 of the Earth Summit in Rio de Janeiro (UNCED, 1992). It is argued that the United Nations Conference, held in Mar del Plata in1977, which was endorsed by all member governments, had more to say on IWRM than the Dublin Conference, which did not even have any governmental approval (Biswas, 2004). The Dublin principles are as presented below:

- Fresh water is a finite and vulnerable resource, essential to sustain life, development and the environment.
- Water development and management should be based on a participatory approach, involving users, planners and policy-makers at all levels.
- Women play a central part in the provision, management and safeguarding of water.
- Water has an economic value in all its competing uses and should be recognised as an economic good.

Table 2.1: IWRM related concepts compared

Concept	Explanation
Integrated Catchment Management (ICM)	Environmental planning which tackles sustainable resource management from a catchment perspective as opposed to the piecemeal approach that separate land from water management.
Integrated River Basin Management (IRBM)	The management of water systems as part of the environment; entails the technical, socio-economic and ecological aspect of the river basin
Integrated Resources Management (IRM)	Recognizes the interactions between resources and the resource users as well as their impact management solutions. IRM aims to balance social, economic and environmental demand on resources to ensure sustainable use and reduce conflict.
Integrated Resources and Environmental Management (IREM)	IREM is both a management process and a philosophy that takes into accounts the many values associated with natural resources within a particular area.
Watershed Management	The process of generating and implementing programs to sustain and enhance watershed functions that affect ecology and human communities within a watershed boundary.

Source: Agyenim (2011)

2.9 Water Conflict and Resolution Mechanisms

Water management is, by definition, conflict management (MacQuarrie *et al*., 2008). The management of water is not based on a single purpose but a multi faceted one acknowledging the various competing uses. It is widely acknowledged that conflicts arise from opposing interests such as competition over scarce resources, differences in perceptions and attitudes of water use and thus increasing interdependence among users. Warner and Jones (1998), looked at conflict as negative connotations, being perceived as the opposite of peace and cooperation, and commonly associated with violence or the threat of violence. The issue of water conflict is usually aggravated if international waters are involved (Wolf, 2007). Ohlsson (2000) makes a distinction between different types of conflicts namely; the first-order conflicts and the second-order conflicts. The first order conflict according to Ohlsson (2000), results due to

natural resource scarcity whiles the second order conflict results from adaptation strategies which societies use to overcome natural resource scarcity.

2.9.1 Water Conflict and Cooperation

Water conflicts result mainly due to issues concerning quantity, quality or timing (Carius *et al.*, 2004). Of all the above mentioned water related concerns, the issue of limited quantity of water is by far the most obvious reason for most water related conflicts. The potential for tensions over allocation increases when the resource is scarce. This is further aggravated with the existence of multiple users with conflicting interests. Another contentious issue is water quality. This makes water inappropriate for drinking, industry, and sometimes even agriculture. Dispute can thus erupt between the polluters and those affected by the pollution. The issue of timing of water flow is also important when talking of water conflict. More often than not the driving forces behind water related conflicts are local in nature (Carius *et al*., 2004; Wolf *et al*., 2003) and so are the potential solutions to conflict over water (Wolf, 2007).

Notwithstanding the issues of conflict in the use of water, it has been recommended that water can also be perceived as a means to cooperation (Uitto, 2002). Cooperation could be achieved by involving conflicting interest in decision making, providing fora for negotiation and encouraging stakeholder participation during planning and development (MacQuarrie *et al.*, 2008). Success stories of the use of cooperation in dealing with water conflicts are in the Nile and Columbia River basins. In Ghana, the negotiation principle for water and land use employed in Binduri, a community in the White Volta is also seen to be a successful cooperation strategy (Ampomah, 2008).

3. STUDY AREA

3.1 Location and Size

The Upper West region (Figure 3.1) is located in the north western part of Ghana. Geographically, it is located between longitude 1º25" W and 2º45"W and latitude 9º30" N and 11ºN. The region is bordered on the north by the Republic of Burkina Faso, on the west by Cote d'Ivoire, on the east by the Upper East region and to the south by the Northern Region. The region covers a total land area of approximately 18,478 sq.km. This forms about 12.7% of the total land area of Ghana. Administratively, the region is made up of nine (9) districts. The districts are namely; Wa municipality, Wa East, Wa West, Nadowli, Jirapa, Lawra, Lambusie Karni, Sissala West and Sissala East. (GSS, 2005)

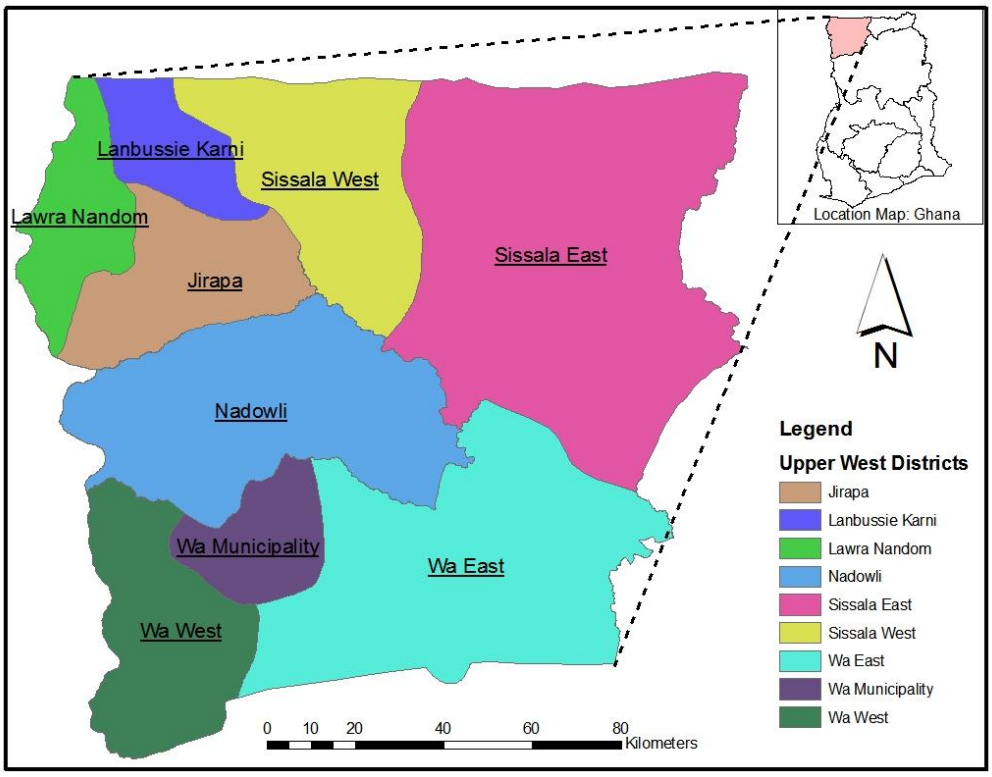

Figure 3.1: Upper West Region map showing districts and study communities (Source: Author's Map)

3.2 Socio-Economic Characteristics

The main economic activity within the basin is agriculture with crop farming and livestock production being dominant. Crop farming is dominated by smallholder farms characterized by low input technologies and low yields and outputs. In some areas, particularly in the Upper West Region, population pressure has caused a reduction in the fallow periods for shifting cultivation (Bambangi, 2010). The major annual crops are classified as cereals, root crops and vegetables. The major cereals are rice, maize, millet and sorghum. However, millet and sorghum are mainly grown in the savanna zone. Cassava is grown almost everywhere in the basin, however in small scale in parts of the Upper West. The cultivation of yam is concentrated mainly in the transition and Guinea Savanna zones. Groundnuts, bambara nut and beans are also largely cultivated within the basin. Livestock production constitutes an important component of the economy of the Black Volta basin, particularly in the savanna areas of the basin. According to Asamoah and Kotartsi (1997) livestock production was projected to grow at an annual rate of about 10 percent between 1995 and 2020. Presented in Table 3.1 is the estimated and projected population of livestock in the basin with corresponding water demand.

Table 3. 1: Livestock population and livestock water demand in the BVB

Year	1995	2000	2005	2010	2015	2020
Population	1,667,618	2,101,165	2,672,976	3,429,343	4,435,516	5,779,737
Water demand ($10^6 m^3$)	3.40	3.80	4.20	4.70	5.30	6.00

Source: Asamoah and Kotartsi (1997)

3.3 Population Size and Density

According to the 2010 Population and Housing census, the population of the region stands at 702,110. Out of this, males form 48.59 % (341,182) and females constitute 51.41 % (360, 928,). The population of the region forms 2.8 % of the total population in Ghana. On the average, population density of the region is 38 persons per square kilometre. This is lower than the national average of 103 persons per square kilometre. Notwithstanding this, a higher population density of 97 persons per square kilometre is recorded along the Western corridor of the region especially in the areas of Lawra, Jirapa and Nadowli. Sissala East district has the lowest density of about 11 persons per square kilometres. (GSS, 2000; GSS , 2010).

3.4 Geology and Soil

3.4.1 Geology

The geology of the basin is that of granitoids comprising mainly of 33% Voltaian system, 20% cape coast granite, 15% dixcove granite, 20% and 10% of both lower and upper Birimian system respectively as well as 2% of Tarkwaian formation. (Adu, 1995; Kortatsi, 1997). The cape coast granite is made of well foliated, medium grained potash-rich muscovite-biotite granite, granodiorites, pegmatites, porphyroblastic-biotite gneiss and aplites. The geographical location of this formation is between latitudes 9ºN to 11ºN and longitude 2º 25'W to 4º 40'W. The Voltaian system is also located within latitudes 7º 31'N to 9º 5'N and longitudes 1º 5'W to 2º 10'W (Kortatsi, 1997).

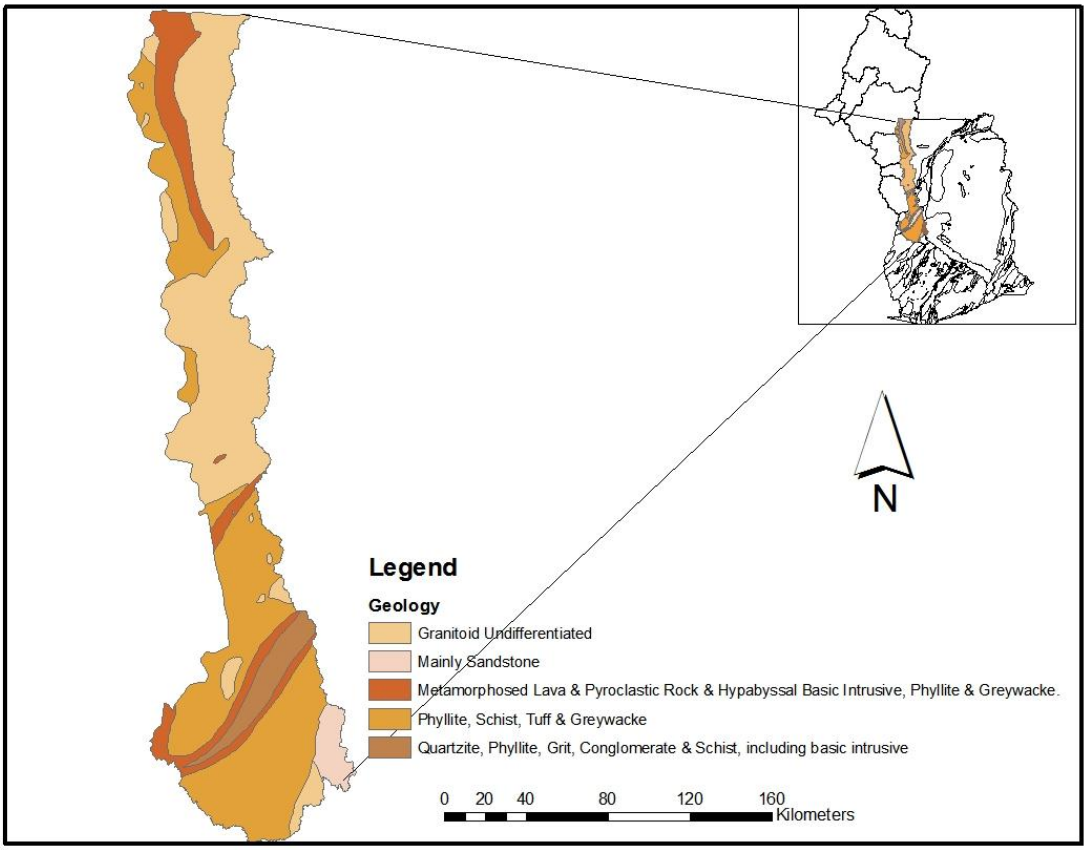

Figure 3.2: Geological formation of the Black Volta Basin in Ghana
(Source: Author's Map)

3.4.2 Soils

The main soil groupings of the basin are namely luvisols, nitosols, acrisols, cambisols, lithosols, regosols, arenosols, vertisols and fluvisols. The predominant texture of the savannah lithosols is that of medium to light (Andah, 2005). Due to the non-cohesiveness of the lithosols they are often susceptible to severe gully erosion. This results in less organic matter and lower nutrients in this soil formation. Luvisols as a soil group is made of strong accumulation of clay in the B-horizon and the clay is known to have a high cation exchange capacity (FAO, 1988). Alluvial and floodplain soils with little profile development also exist in the basin. This type of soil is good for the cultivation of rice in the basin.

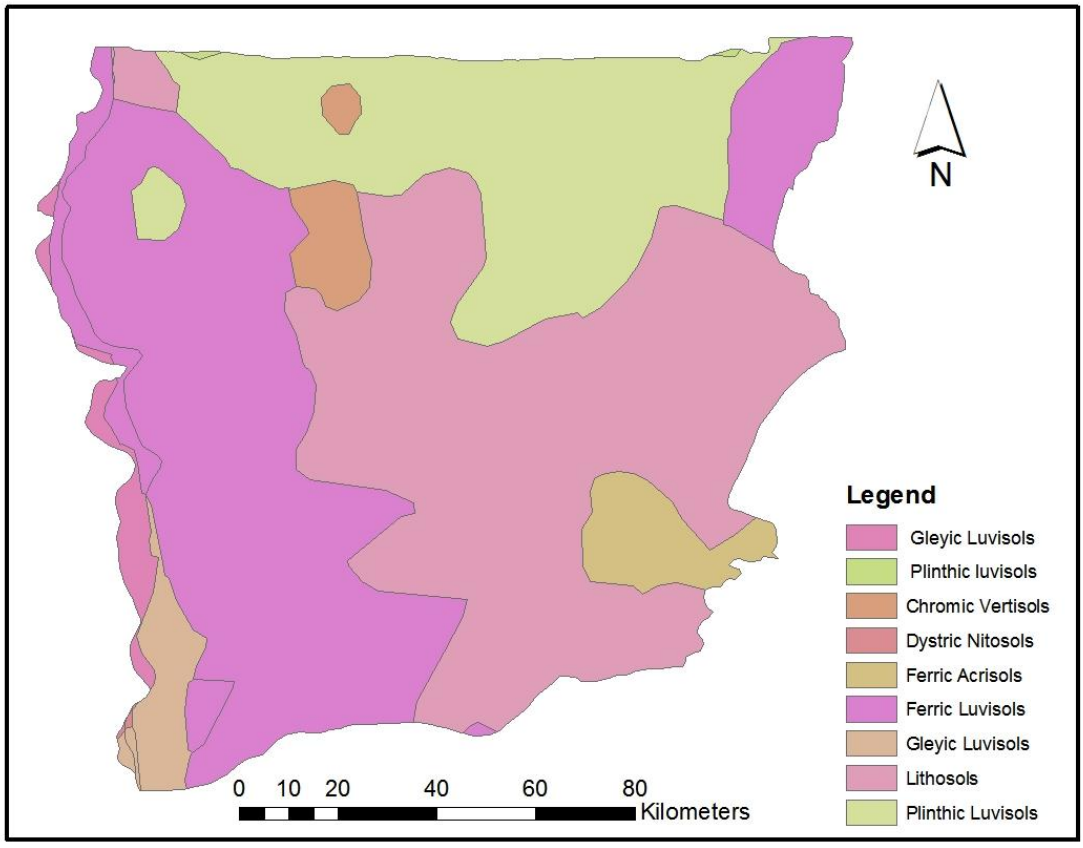

Figure 3.3: Soil map of UWR

(Source: Author's Map)

3.5 Climate

The region is characterised by both dry and wet seasons. In the dry season, temperature is about 29ºC during the day and about 21ºC during the night (Agorsah, 2003). The mean annual temperature is about 27.06ºC. The northern part of the basin experiences only one major rainy season which starts in April and peaks in September. This makes rain-fed agriculture in the region unsustainable. With regards to the southern sector of the basin, two rainy seasons occur, starting in March through peaking in November. Annual rainfall ranges from 1150mm to 1380mm in the north and south of the basin respectively. Humidity of the area is as low as 59% in the areas

of Lawra, Jirapa, Nadowli and Wa (Barry *et al.,* 2005). The potential evapotranspiration also ranges between 1450mm and 1800mm (Andah *et al*, 2005).

3.6 Vegetation

The region is characterized by two main agro-ecological zones namely, the guinea savannah and the sudan savannah. The guinea savannah zone which covers the southern portion of the region contains drought resistant tree species such as dawadawa (Parkiaclappertoniana), shea trees (Butyrospermumparadoxum subsp. parkii), Isoberinadoka, Isoberinadalzieli, Daniella spp., mahogany (Khayaseneqalensis). The sudan savannah also covers the northern and north eastern part of the region. Among the tree species found in this zone includes Baobab (Adansoniadigitata), dawadawa (Parkiaclappertoniana), shea (Butyrospermumparadoxum subsp. parkii) and Acaciaalbida (GEF-UNEP, 2002; MoFA, 2011). The heterogeneous collection of trees provides all domestic requirements for fuel wood and charcoal, construction of houses, cattle kraals and fencing of gardens. The shorter shrubs and grass also provides fodder for livestock.

3.7 Topography and Drainage

The relief of the Black Volta ranges between 60m and 762m with an average of 287 m (Moniod *et al.,* 1977). This increases from the south to the north (Andah *et al.,* 2003). The main Volta is generally below 150m with a few areas around the rim of the basin attaining altitudes of more than 300m above sea level. Greater proportion of the Black Volta basin falls within the savannah zone which is undulating with gentle slopes that promote overland flow. The region is drained mainly by the Black Volta to

the west, Kulpawn at the middle portion of the region and Sissili to the east of the region (Figure 3.4)

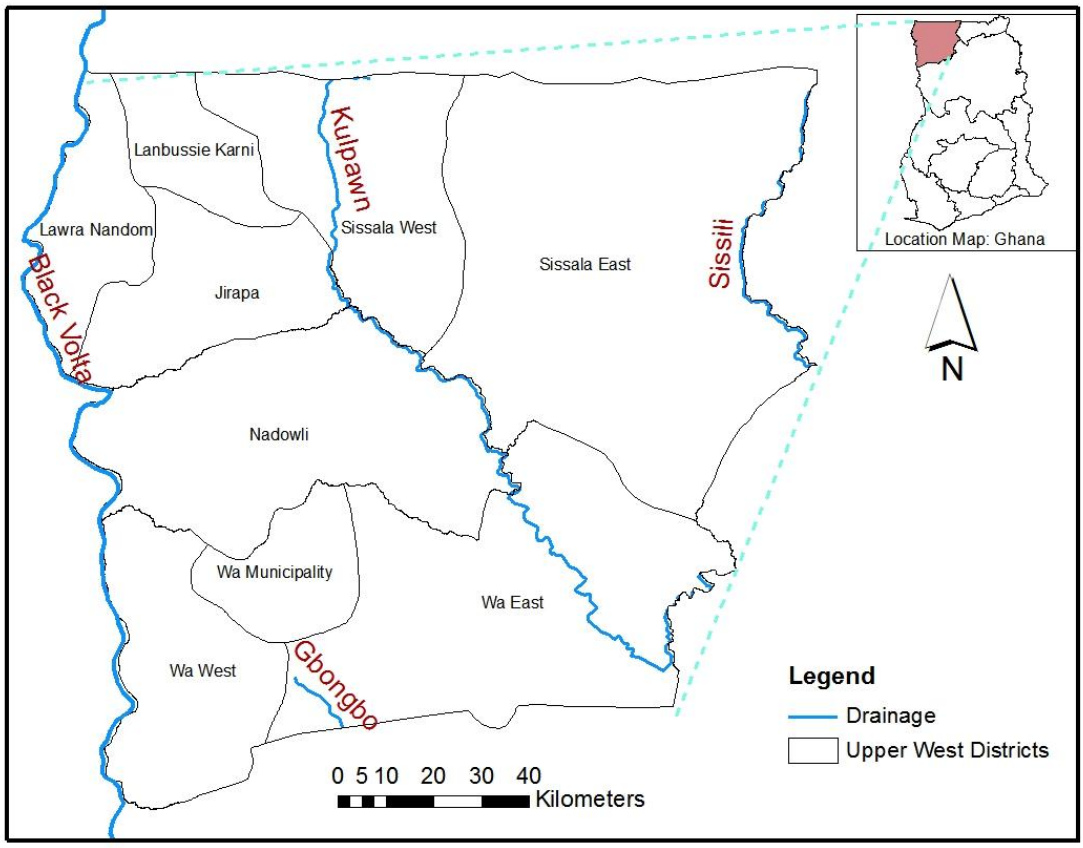

Figure 3.4: Main drainage network of UWR

(Source: Author's Map)

3.8 Land Use

The major land use of the region is agriculture with extensive bush fallow cultivation under food crops. The major food crops include sorghum, millet, groundnuts and beans. The northern and middle parts of the basin have seen an increase in animal numbers due to the free range system that is practiced. Gold mining in the Birimian rocks is also an activity that is gaining grounds with urban land use being most intense in Lawra and Wa (Andah *et al*, 2003).

4. RESEARCH METHODOLOGY

This chapter focuses on the research methodology adopted in this work. It discusses the selection criteria used for the communities, the types of data to be collected to answer the specific objectives and hence the main objective.

4.1 Selection of Study Communities

The selection of the study communities were informed by the following factors;

- Availability of data
- Proximity of communities to the Black Volta river
- Accessibility of communities

Five communities were finally selected for the study based on the above criteria (Table 4.1). The selected communities are Bagri Zongo and Dabagteng in the Lawra district. The others are Kpaala and Tanduori in the Nadowli district and Wechiau in the Wa west district. Presented in Figure 4.1 is the Upper West Regional map showing the geographic locations of the study communities.

Table 4.1: Geographic coordinates of study communities in decimal degrees

Community	Coordinates (Decimal Degrees)	
	Latitude	**Longitude**
Bagri Zongo	10.729833	-2.922889
Dabagteng	10.893861	-2.814972
Kpaala	10.263639	-2.746472
Tanduori	10.367583	-2.794778
Wechiau	9.82885	-2.681965

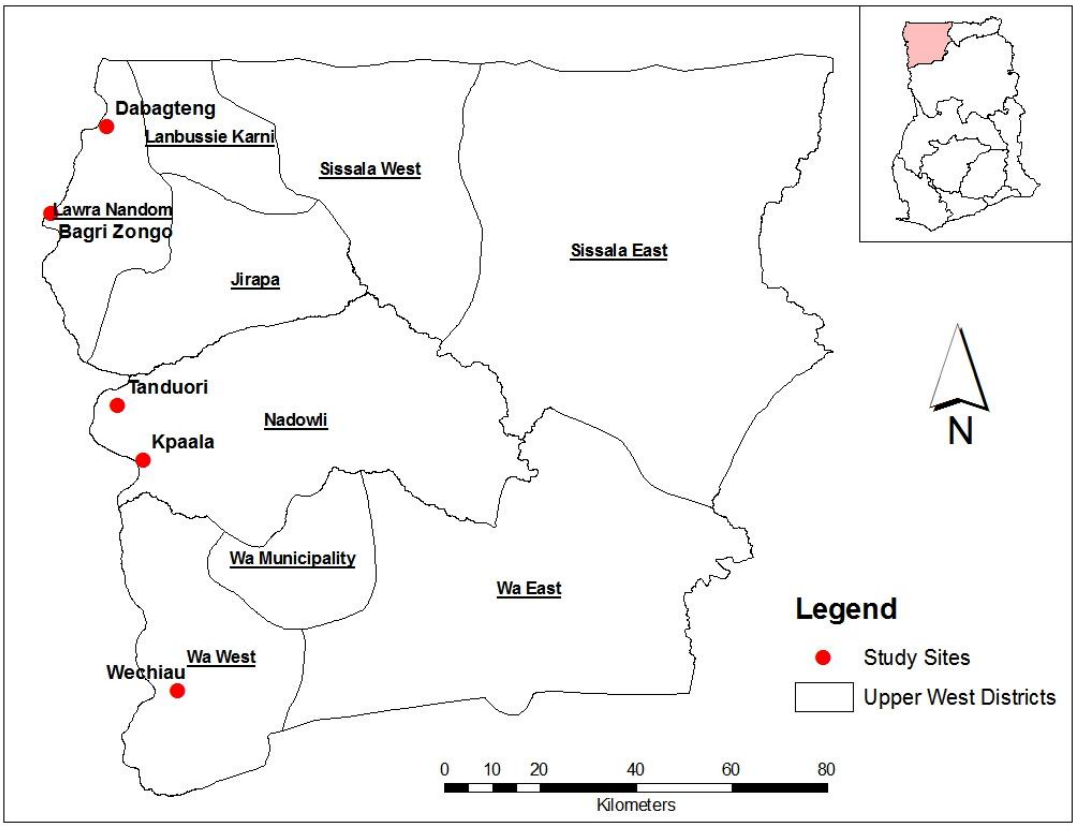

Figure 4.1: Geographic location of study communities in UWR of Ghana
(Source: Author's Map)

4.2 Desk Study

Literature review of technical reports, peer-reviewed journals, documents of relevant agencies such as GIDA, WRC, etc was done. Information was also obtained from the internet. This was done to gain in depth knowledge of the topic under study and to draw comprehensive lessons that were key to the advancement of this research work.

4.3 Sources of Data

Data for the study were obtained from two main sources, namely primary and secondary sources. The primary data were obtained through FGDs, key informant interviews and questionnaire administration. Stakeholders from which the primary

data were obtained include WUAs (farmer groups and fishermen groups), Assembly men, Chiefs and Women groups within the study communities.

The data collected included issues on their perceptions about water resources, water related conflicts, water use practices and involvement in the management of the resource, local knowledge in water resource management, the responsibilities of traditional institutions, control and ownership of the resource as well as institutions that are involved in water management at the local level. Interviews with Heads of water agencies and NGOs that deal with water were also undertaken.

Secondary data were also obtained from agencies such as NGOs, GIDA, WRC, MoFA, EPA and District Assemblies.

4.4 Key Informant Interview

At the community level, information was obtained from the community leaders (Chiefs, Assembly men, etc.), Executives of WUAs (farmer and fishermen groups) as well as Executives of women groups (Plate 4.1). Where appropriate the key informant questionnaire (see appendix A) was used to collect the required data. Key persons concerned with the management of water both at the regional and district levels were also interviewed. Information was also obtained from local NGOs that are involved in water related programmes in the study communities.

Plate 4. 1: Interviews in Kpaala and Bagri Zongo

4.5 Focus Group Discussion (FGDs)

Within each study community one focus group discussion was held to solicit for their views on how water resources are being managed (Plate 4.2). The target groups for the FGDs were the WUAs namely, the farmer and fishermen groups. Each focus group was made up of 8 members comprising both males and females. The participants were purposively selected from the various local groupings. The focus group discussions held in each community addressed the following;

- Water sources and uses in the community
- Problems and potential solutions with water resources in the community.
- Local institutions for water management.
- Indigenous water management practices

As a crosscheck to the notes taken during the discussion, a tape recorder was also used to get the audio version of the discussions.

Plate 4. 2: Focus group discussion sessions in Tanduori and Dabagteng

4.6 Questionnaire Design and Administration

4.6.1 Questionnaire Type and Sample Size

One of the research tools used in gathering data was the questionnaire. Considering the research topic and how perceptions, beliefs and norms influence the use and management of water, structured and semi-structured questionnaires were deemed appropriate (see appendix B). The semi-structured questionnaire gave room for respondents to give in depth information with regards to the water resource use and management. At a confidence level of 95 percent and confidence interval of 0.1, a total of 100 household questionnaires were administered across the five communities.

4.6.2 Questionnaire Administration

Within each community, twenty (20) questionnaires were administered. The respondents were randomly selected to include all water users namely; farmers, pastoralist, fishermen as well as domestic users. The questionnaire was designed taking note of the following:

- Water use and allocation practices

- Water related conflicts and resolution
- Indigenous water management practices.

Respondents were approached either on their farms or at home. During this time, the purpose of the study was made known to them after which consent was sort to start the interview. Respondents were also made aware of anonymity and that information given was only for the purposes of the study. On the average, each interview lasted for about an hour. In all, the responses to the research questions were overwhelming, looking at the enthusiasm with which respondents answered the questions. The level of enthusiasm achieved was due to consultation of community leaders during community entry and the involvement of some of the community leaders in the whole research process.

4.7 Data Analysis

The data collected was analyzed with the Statistical Package for Social Science (SPSS) and MS excel. Descriptive statistics such as frequencies and cross-tabulations were used to display the results. The information generated through key informant interviews, focus group discussions and observational data were also described and captured appropriately. For easy comprehension, most of the results have also been shown through the use of graphs.

5. RESULTS AND DISCUSSIONS

This chapter presents results obtained during the research study. It includes water resources related livelihood strategies, potential sources of conflict and their resolution mechanisms as well as traditional water management practices. The results of the research findings have been presented using cross tabulations and graphs.

5.1 Socio-Economic Profile of Study Communities

5.1.1 Major Livelihood Strategies

Using the methodology as outlined in chapter 4, the economic activities identified during the study were crop production, livestock production, fishing and trading. From Figure 5.1, it is shown that the dominant economic activity is crop and livestock production with 62% of the respondents practicing this livelihood type. The remaining proportions of livelihood strategies were 13%, 12%, 11% and 2% for fishing, trading, crop production only and livestock production only respectively. On community basis, Tanduori recorded the highest number of respondents (75%) who are involved in crop and livestock production as compared to the 70% that exists in Wechiau. Very few people engage in either crop production or livestock rearing. This could be attributed to the fact that keeping only crops or livestock does not guarantee food security and as such most of the inhabitants consider both crops and livestock at the same time thus contributing to the higher percentages recorded for those involved in both crop and livestock rearing (Figure 5.1). Trading as a livelihood strategy includes sheanut extraction, pito (local alcoholic beverage) brewing and retailing of vegetables and millet. Among the study communities, Bagri Zongo and Wechiau recorded the highest (15%) in trading activities. In Bagri Zongo, 35% of the respondents engage in fishing activities compared to 20% and 10% in Dabagteng and Kpaala, respectively.

As shown in Figure 5.1, none of the respondents in Wechiau and Tanduori were involved in fishing. According to key informants, the fish catch has reduced tremendously thus the vibrant fishermen have migrated to other communities. Among the reasons for such an occurrence, is the reduction in the water levels in the Black Volta River due to siltation which comes about as a result of the farming activities along the banks of the river. Mention was also made of the use of fertilizers in farming activities which eventually end up in the river causing pollution and consequently affecting fish yield. These reasons were seen to be potential sources of conflict since they threaten the sustenance of those who depend on the water resource for their livelihoods.

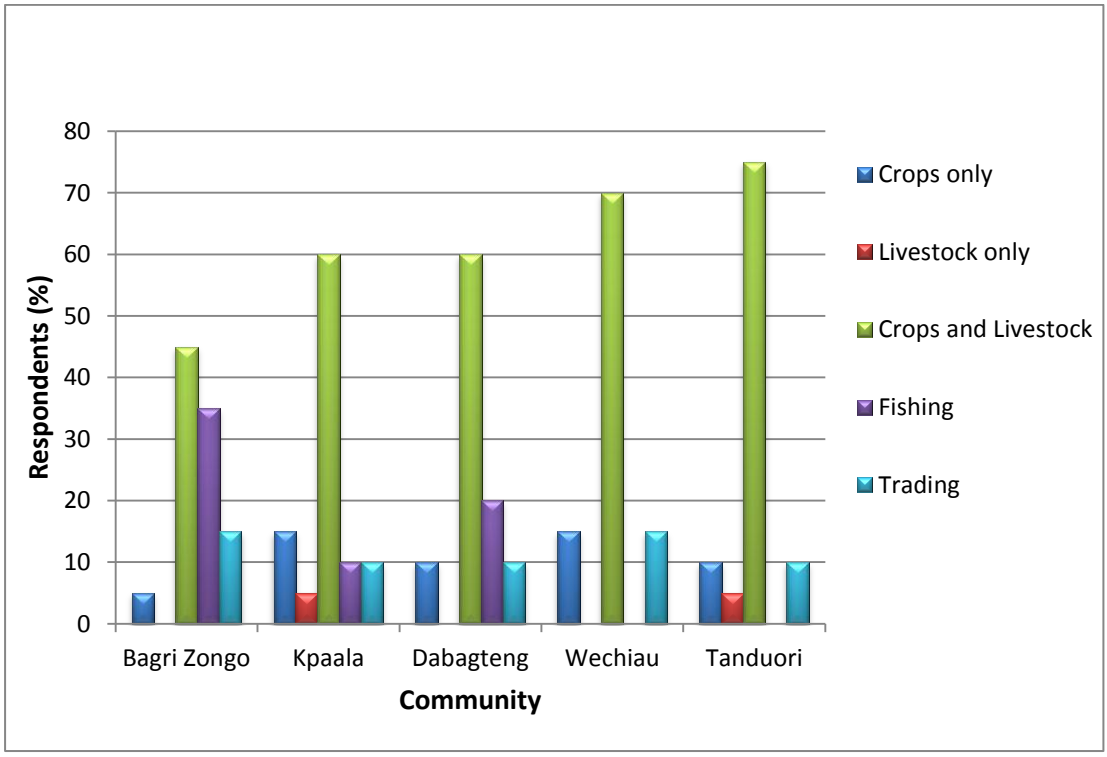

Figure 5.1: Existing livelihood strategies across study communities

In order to appreciate their livelihood strategies, the type of agriculture that is being practiced was also looked into. Figure 5.2 below, indicates that the most practiced agricultural type is rain-fed followed by both rain-fed and irrigation. It was revealed

that 82% of respondents across all study communities practice only rain-fed agriculture with only 18% practicing both rain-fed and irrigation. However, due to the long dry season those who solely depend on the rains for their agricultural activities thus remain dormant most of the time. It is seen in the Figure 5.2, that both rain-fed and irrigation is high in both Wechiau and Tanduori. This is attributed to the presence of dugouts/small dams within these communities.

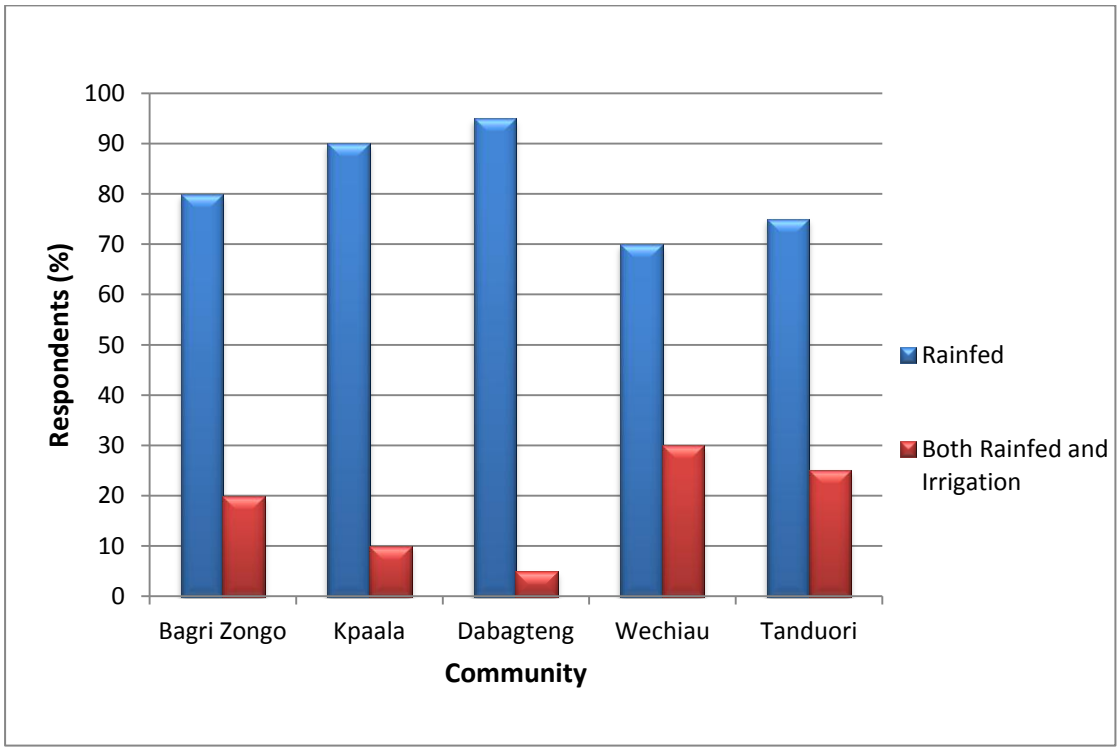

Figure 5.2: Existing agricultural type

5.1.2 Household Income Level in the Study Area

From the study, information about the income level per month for the study communities is as presented in Figure 5.3. Across the five communities, 21% of the respondents earn less than GH¢20 a month, 35% earn between GH¢ 20-50 and 28% earn between GH¢51-100. Only 16% of all the respondents earn income above GH¢100. Using the prevailing average exchange rate of GH¢ 1.8 to the US Dollar at

the time of data collection, each household with an average size of 6.2 (GSS, 2010) lives on $0.30/capita/day or even less. This is far below the $1.25/capita/day stipulated by UN (2007) to be the international poverty threshold line. The results also agree with the GLSS 5 report of the Ghana Statistical Service where the Upper West region was mentioned to have the lowest per capita income. This shows that the inhabitants of the study communities are poor. According to the UN estimates (2007), 21% - 40% of the population in Ghana lives on less than $1.25/day. This implies that, the over 84% of respondents who live on less than $1.25/day within these communities form part of this captured range. The low earnings in income could thus be attributed to the nature of agricultural and other economic activities within these communities. Regarding sustainability of the various livelihood strategies in terms of income generated, only 5% of respondents said their livelihood sources were sustainable.

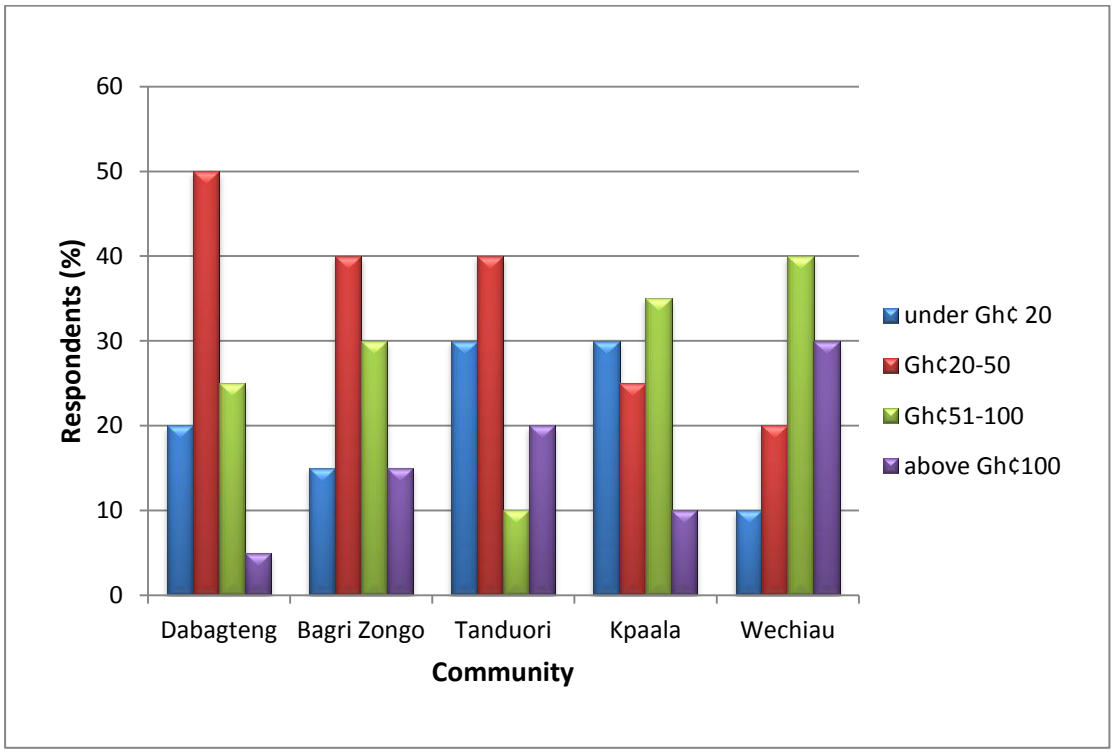

Figure 5.3: Household income level by community

5.2 Identified Water Resources and Their Uses

In an attempt to appreciate how water resources affect the various livelihood strategies, the respondents were asked about their sources of water for the various water uses, the proximity of these water sources and their reliability. With respect to this study, proximity is taken to mean the distance, in kilometers, of the water source from a particular household. Reliability of a water source is also taken to mean the ability of the water source to provide water for a given year. The major sources of water identified are borehole, dugout and the Black Volta River. These sources of water are used for various purposes such as domestic, livestock watering and irrigation (small garden watering).

5.2.1 Domestic Water Use

Domestic use of water includes water for drinking, cooking, bathing and washing (Bustamante, 2004). Three sources of domestic water were identified and these are namely; boreholes, dugouts and the Black Volta river (Figure 5.4). From the study, a 100% was recorded for all communities for the use of Borehole as the primary source of domestic water. This is due to the presence of boreholes throughout all the study communities. Water from the boreholes is supplemented with water from other sources such as dugout (Plate 5.1) and the Black Volta River with average of 19% of respondents supplementing using water from dugout and average of 34% using water from the river. The remaining 47% of the respondents do not use either dugout or river but rely solely on borehole for their domestic purposes. Among the study communities, dugouts were found in only Tanduori and Wechiau. Though Dabagteng had one dugout, it was not functional because its embankment had collapsed. Tanduori had one (1) dugout compared to the two (2) in Wechiau. Considering

proximity of the primary water source, 84% of respondents said they leave within 1km of the water source whiles for the remaining 16% live within 1-3km. Comparing this to the WHO standards, 84% have domestic water access, whiles 16% have poor access (WHO, 2005). According to 97% of respondents across the five communities, the reliability of the boreholes is guaranteed.

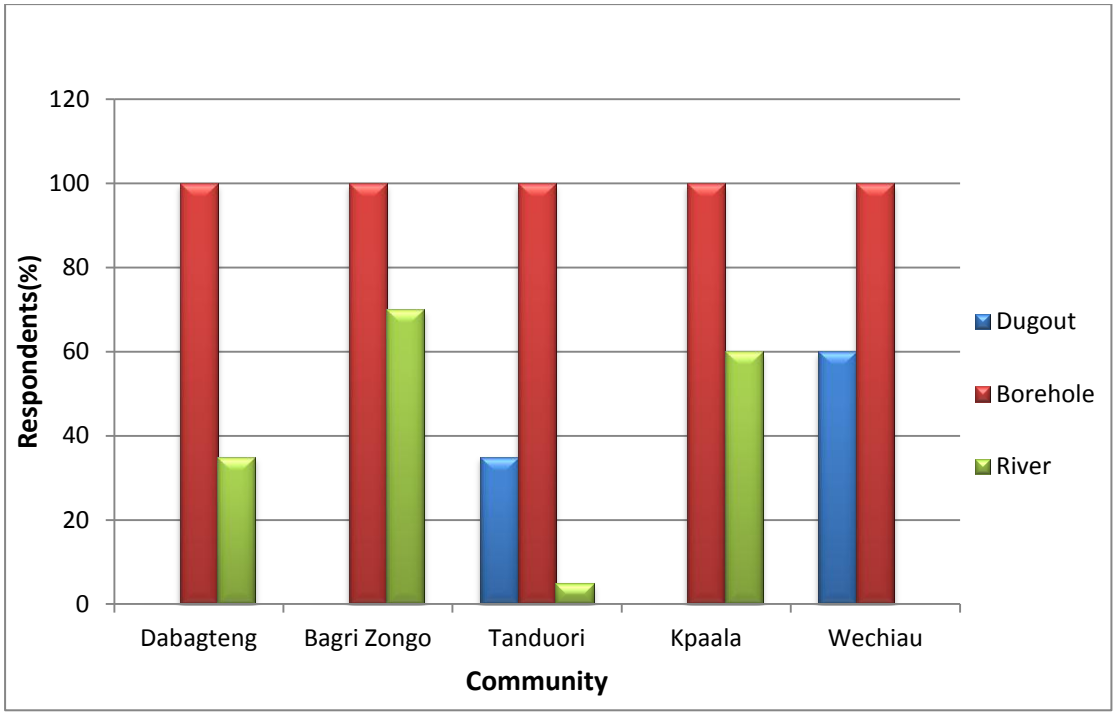

Figure 5.4: Sources of water for domestic purposes

Plate 5. 1: A dugout in Wechiau

5.2.2 Livestock Watering

The major sources of water identified for livestock watering were dugouts, boreholes and the river (Figure 5.5). The results indicate that 52% of respondents water their livestock using the borehole, 30% using the dugouts and 18% also use the Black Volta River. From Figure 5.5, it is shown that 85% of the respondents in Wechiau water their livestock from dugouts as compared to 65% in Tanduori. Due to the absence of dugouts in Dabagteng, Bagri Zongo and Kpaala, livestock watering in these communities is mainly done from the boreholes (Plate 5.2). Those who water using the river are basically involved in the rearing of cattle (Plate 5.3). In Bagri Zongo, a greater proportion of the respondents are involved in cattle rearing thus the corresponding higher percentage (45%) in the use of the river for livestock watering. Interviews with key informants revealed that, the dugouts holds water during most part of the year with the water level reducing considerably getting to the latter parts of the dry season. Proximity of livestock water sources are within less than 1km for 67% respondents, 29% between 1-3km and 4% between 3-6 km. Therefore, majority of livestock keepers have access to water within a distance of less than 1km.

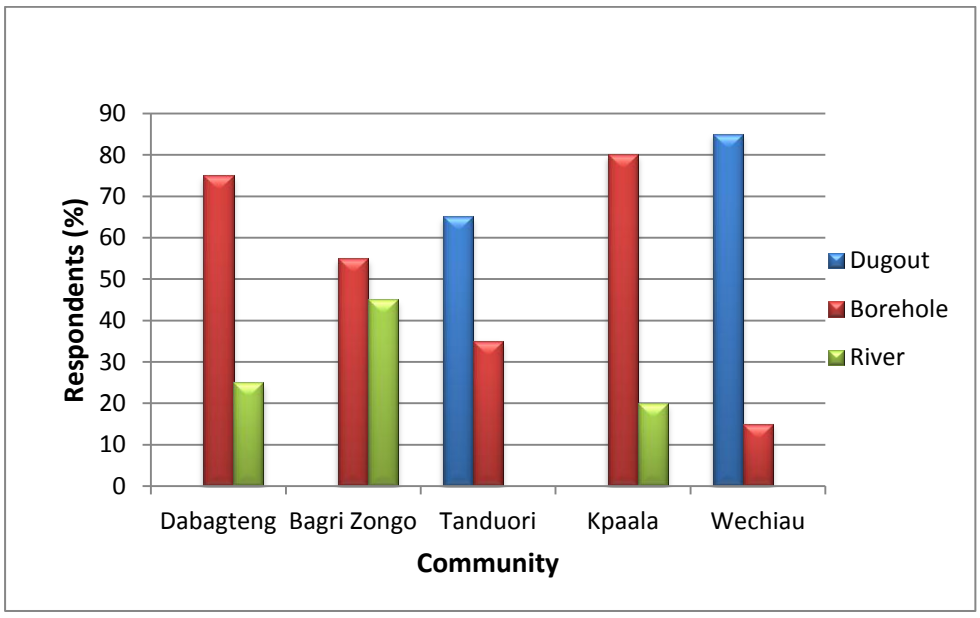

Figure 5.5: Sources of water for livestock watering

Plate 5. 2: Livestock watering points at the boreholes

Plate 5. 3: Livestock watering from the Black Volta River

5.2.3 Water for Irrigation

As part of livelihood strategies, irrigation (small garden watering) is practiced across all the communities. The major crops that are cultivated are tomatoes, okro and tobacco. A greater proportion of the respondents (60%), irrigate their gardens with water from the Black Volta River with 34% using dugouts and 6% using borehole water. The 34% of the respondents who use dugout are found mainly in Tanduori and Wechiau. The use of the Black Volta River for irrigation is predominant in Bagri Zongo, Dabagteng and Kpaala (Figure 5.6). This is due to the absence of dugouts in these communities and thus the respondents rely on the Black Volta River for irrigation. In Bagri Zongo, intensive gardening along the Black Volta cannot be overlooked (Plate 5.4). This has caused the removal of the vegetative cover causing siltation of parts of the Black Volta River. However, in Tanduori, irrigation of gardens is done with water from the boreholes and the dugouts but not the river. This community is not practicing bank farming due to the sensitization given them on the effects of bank farming by Care Ghana. Majority of the respondents (73%) had their gardens within less than 1km to the particular source of water for irrigation.

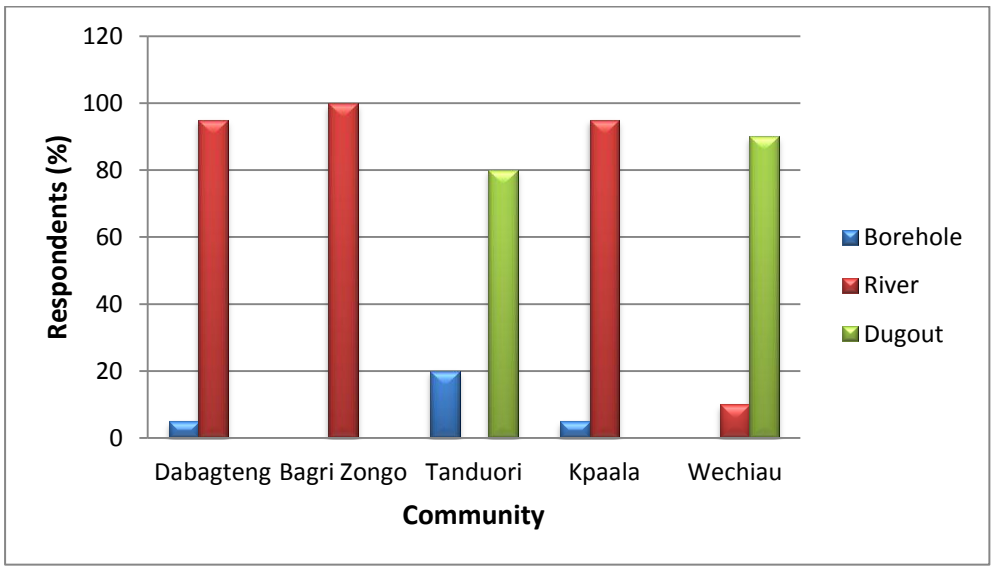

Figure 5.6: Sources of water for small garden watering

Plate 5. 4: Gardening along the Black Volta River

5.3 Water Access

Water access as used in this context refers to the ability of the community inhabitants to make use of the available water resources. To ensure the judicious use of water resources, rules and regulations are established to govern how these resources are managed. In this section, the rules and regulations governing water resources, the relevant authorities responsible for water management at the local level together with indigenous management practices are looked at.

5.3.1 Main Institutional Actors

The presence of institutional actors at the local level was paramount with considerable positive impact on sustainable natural resources management. One of such key institutions is embodied in the traditional system of governance at the local level. For all the five communities, reverence was given to traditional leaders. Top on the

hierarchy of the traditional system of governance is the chief; followed by the Tindana and the Assemblyman. According to the community inhabitants, the chief is the owner of all water resources within the community with the Tindana being the owner of all lands. With respect to land use activities, the Tindana is always informed before any such activity is carried out. These practices regulated the use of water and land resources and by so doing ensuring their sustainability. A key lesson from this is that, since these authorities are highly revered, they can be used as a focal point to enhance IWRM at the community level. In this way, sustainability for both water and land resources will easily be achieved due to community involvement in natural resources conservation (Katerere and van der Zaag, 2004). Highlighted in Table 5.1 are the fundamental roles and functions of the traditional leaders as far as water resources management are concerned. The research also revealed that these traditional leaders carry out their responsibilities to the latter without any remuneration. According to Katerere and van der Zaag (2004), the best approach of ensuring sustainability of water governance is through stakeholder and community based resource management actions. This is clearly seen in the roles and responsibilities of the traditional leaders and hence could be said to be a good initiative towards sustainable management of water resources. Studies in other African countries (Nompumelelo, 2001) have shown that traditional practices are still in use and have proven to be efficient in the management of water resources. Local management according to van Koppen *et al.,* (2004) is thus seen as the best option for the management of water resources at the local level.

Table 5.1: Fundamental roles and functions of traditional leaders in water management

Leadership Type	Roles and functions
Chief	• Managing water conflicts and disputes. • Ensuring conservation and protection of water sources. • Ensuring availability of water in community.
Tindana	• Managing and controlling land resources. • Liaise with chief to settle disputes. • Ensures conservation of natural resources.
Assemblyman	• Liaise with district assembly to provide potable water. • Liaise with WATSAN members to ensure routine maintenance of boreholes.

5.3.2 Knowledge on Rules Governing Water Resources

In order to understand the rules governing the use of water resources, respondents were asked about their knowledge on the existence or otherwise of any existing rules. The findings are as presented in Table 5.2.

Table 5.2: Knowledge on rules regarding various water uses

Water Use	Existence of rules on different water uses	
	Yes (%)	**No (%)**
Domestic water	80	20
Livestock watering	28	72
Irrigation (small garden watering)	27	73

From Table 5.2, 80% of all respondents knew the existence of rules governing the use of water for domestic purposes. Among such rules are no washing in dugouts, no one is denied access to domestic water, payment of fees for maintenance of domestic water sources, first come first serve basis. The higher percentage recorded on rules governing domestic water sources is an indication of the importance attached to this particular source of water. Since domestic water is crucial for the well being of community inhabitants, such rules are made known and strictly adhered to.

On the contrary, knowledge on rules pertaining to sources of water (dugouts and river) for livestock watering and irrigation were very scanty. It was revealed from the study that, 28% and 27% of respondents knew the existence of rules governing abstraction and use of water for livestock and irrigation respectively. At the dugouts, livestock are watered at designated points and cleaning of livestock around the dugouts was also prohibited. Other rules include the maintenance of clean cistern which holds water at the borehole sites. The various rules pertaining to each type of water use are most often instituted by traditional leaders, the community members and other relevant authorities. The involvement of the local communities and water users in decision making processes in itself averts controversy and conflicts as far as the management of the water resources are concerned (Carius *et al.,* 2004). In Table 5.3 are the various relevant authorities concerned with the legislation of rules for the management of water resources.

Table 5.3: Knowledge on authorities for water legislation at the local level

Authority	Water use type					
	Domestic (%)		Livestock (%)		Irrigation (%)	
	Yes	No	Yes	No	Yes	No
Traditional leaders	44	56	14	86	17	83
Community	24	76	13	87	8	92
WATSAN	12	88	25	75	2	98

From Table 5.3, respondents who answered in the affirmative indicated that traditional leaders play a major role in the governance of water resources compared to the role played by the community and the WATSAN. Traditional leaders carried out this role through the institutionalization of rules and regulations that govern water resources. This was confirmed with responses from key informants. These actions are not done in isolation but in consultation with community members and the WATSAN committee. Generally speaking the knowledge on authorities for water legislation was scanty as could be inferred from Table 5.3

5.4 Priority of Water Use

An important principle that exists in all the communities is the priority of water use doctrine. In the event of scarcity of water resources, this principle provides for a means of allocating the resources between the different types of uses. To better understand the local way of prioritizing water, inhabitants were asked about their priority of water use in case of scarcity and the responses obtained are as shown in Table 5.4. From the table, it is clear that in terms of prioritizing water, water for

domestic purposes comes first. This is because water for drinking, bathing and cooking are considered essential for human survival. The next in line in terms of priority of water use was for livestock watering followed by irrigation. Sixty four percent out of the 100 respondents agreed to water their livestock than to farm in times of water scarcity. This is an indication of how the study communities will preserve water for their livestock at the expense of cropping activities. The above trend of prioritizing water is the same as that identified by Wolf (2002) among the Berbers of Northern Africa. Among this group of people, highest priority is for drinking water for humans, followed by drinking water for animals both of which were considered sacrosanct and neither may be denied anyone for any reason at any time. The next priority was water for irrigation.

By prioritizing uses of water, risk can be distributed more equitably by allowing critical uses to have the high priority in times of fluctuating supply. Wolf (2002) also illustrates this potential benefit of prioritizing water use among the Berbers and Bedoiuns of Northern Africa.

Table 5. 4: Scale of priority of water use

Community	Domestic (%)	Livestock watering (%)	Irrigation (%)
Dabagteng	100	35	65
Bagri Zongo	100	55	45
Tanduori	100	80	20
Kpaala	100	95	5
Wechiau	100	55	45

5.5 Management of Water Infrastructure.

The identified water infrastructure in the study communities are mainly boreholes and dugouts. Boreholes were found in all the communities. Unlike the boreholes, dugouts were found in only two of the study communities; namely, Tanduori and Wechiau. These infrastructures though built by NGOs such as Care Ghana, are owned and managed by the beneficiary communities. From interviews conducted, the operation, maintenance and the monitoring of the quality of water from the boreholes are mainly carried out by the WATSANs (Table 5.5). Same applies to the maintenance and quality wise of water in the dugouts. With regards to the operation of the dugouts, it was more a duty of the community than of the WATSAN (Tables 5.5 and 5.6). Notwithstanding the critical role played by the traditional leaders in conflict management, they are also involved in one way or the other in the operation and maintenance of boreholes and dugouts as seen in Tables 5.5 and 5.6.

Table 5.5: Knowledge on authorities for borehole management

Responsible Authority	Operation (%)	Maintenance (%)	Quality (%)	Conflict (%)
Traditional leaders	2	1	3	98
WATSAN	72	97	93	1
Community	26	2	4	1

Table 5.6: Knowledge on authorities for dugouts management

Responsible Authority	Operation (%)	Maintenance (%)	Quality (%)	Conflict (%)
Traditional leaders	10	5	12.5	100
WATSAN	30	57.5	70	0
Community	60	37.5	17.5	0

5.6 Conflict Management and Resolution Mechanisms

One major issue at the study sites was conflict in the use of the water resources among the same users or between competing users. These emerging conflicts are usually resolved by the traditional leaders, WATSAN and the community members as depicted in Table 5.7. This is an indication that the customary way of managing water resources conflict is still in use and effective (Maganga, 1998). Arising issues of conflict pertaining to either the use of the boreholes or dugouts were mostly settled by the traditional leaders.

Table 5.7: Relevant authorities for conflict management

Authority	Domestic (%)	Livestock (%)	Irrigation (%)
Traditional leaders	66	92	95
Traditional leaders and community	21	0	4
WATSAN	13	8	1

As a means of conflict resolution, the traditional leaders together with the community have developed their own adaptive strategies used in conflict management. Following are the potential sources of conflicts and the strategies employed in the resolution of these conflicts.

5.6.1 Negotiation for Land Use

This type of strategy is practiced by two out of the five communities. These communities are those with dugouts namely; Tanduori and Wechiau. Within these communities are established rules that ensure that owners of land close to the dugouts release those lands for reallocation to the whole farming community during the dry

season. More often than not, the reallocation exercise generated conflicts between those whose lands were close to the dugouts and those far from the dugouts. From a key informant, there are times that farmers close to the dugouts are unwilling to give out their land for redistribution. On the other hand, those with land far off were also eager for lands close to the dugouts. Instead of applying the rules which often exacerbated the conflict, the WUA now have adopted the negotiation approach. In this approach, owners of land close to the dugouts are made to understand the importance of collective action in improving their livelihoods. Interestingly, according to key informants, this approach has yielded more results than when the rules were strictly adhered to. This goes to proof a point made by Ampomah (2008) that the application of strict rules and regulations in conflict management may not always be effective. Another type of conflict identified was that between farmers and herdsmen. This type of conflict runs across all the study communities. Since farms are close to dugouts and the river, animals going for watering turn to destroy crops. This at many times has generated conflict between farmers and the herdsmen. By way of managing this type of conflict, designated points have been provided at both dugouts (Plate 5.5) and river for livestock watering. Punishment in the form of a fine is meted out to herdsmen who refuse to water their livestock at the designated points.

Plate 5. 5: Designated watering point at dugout

5.6.2 Introduction of Coping Physical Strategies

In both Tanduori and Wechiau, coping mechanisms have been adopted to increase water storage in the dugouts during the rainy season. These communities carry out manual dredging of the dugouts in the dry season and by so doing increasing the volume of water stored in the rainy season. Another strategy that has been adopted by individual farmers in all the communities is the construction of wells (Plate 5.6) on individual farm plots. These wells are mainly dug at the onset of the rains with the aim of storing water. By this, the pressure on the main sources of water is greatly reduced because most of the farmers have access to water on their own farm plots. From interactions with community leaders, this particular type of strategy has helped in minimizing conflict associated with the reallocation of lands in that farmers far from the dugouts are not so eager to get closer to the dugouts. For that matter, owners of land close to the dugouts can still keep their farmlands without reallocation.

Plate 5. 6: Wells on farm plots

5.6.3 Water Allocation

Among all the study communities water allocation principles was identified in only Wechiau and this concerned the use of the water in the dugouts. In this community, water use for dry season farming was apportioned based on time. With this principle of water allocation, individual farmers were entitled to water for specified hours during the day after which the opportunity reverted to other farmers for the same amount of time. However, from key informants it was revealed that there existed differences between farmers close to the dugouts and those farther away over the time schedule for the release and use of water. The latter complained of not having access to water after those closer to the dugouts have exhausted their time of water use. This came about as a result of the low water levels in the dugouts during the dry season. This issue was resolved through the rescheduling of the time of water use. Allocation of water by time according to Ampomah (2008) has been practiced successfully in Binduri, a community in the Volta Basin. This method of water allocation according to other studies (Ampomah, 2008; Wolf, 2002) helps spread the risk of fluctuating supply as broadly as possible.

5.6.4 Payment and Accountability

Another source of conflict found within the study area was the introduction of payment for domestic use of water from the boreholes. An amount ranging 20-50 pesewas were paid per head for accessing water from the boreholes. The payment of these tariffs created tension, since traditionally no tariffs were paid for accessing domestic water. The information gathered from respondents and key informants indicated that, the operation of the boreholes experienced conflict due to the preferential treatment given to certain water users and allegations of lack of

accountability on the parts of the revenue collectors. An exception to the tariff payments was that found in Wechiau. In this community, water from the boreholes were accessed free of charge. Unlike the other communities, where repair and maintenance of the boreholes were carried out using the tariffs collected, boreholes in Wechiau were maintained by the Hippo Sanctuary tourism centre.

In addressing these issues, a mix of traditional and statutory system has been agreed on. Any conflict that arises out of the use of the boreholes is first tackled by the WATSAN committee. If no amicable solution is reached between the parties involved, the case is then referred to the traditional authorities as the next step.

5.6.5 Siting of Boreholes

One particular conflict that is clearly recurring in many villages is the siting of boreholes. People in different localities seek to ensure that water sources are sited near their own land/homes. For instance, cases of conflict over borehole siting were established in Tanduori and Bagri Zongo communities. Both communities wanted the borehole sunk in their villages.

A significant feature of these conflicts over the siting of particular water points is that they often end up in loose-loose situations whereby projects are stalled or simply withdrawn altogether to the benefit of none (Ampomah, 2008). For instance, an NGO wishing to fund local dam construction in Bagri Zongo ended up withdrawing altogether as the village disagreed over the location of the dam. A number of similar incidents were found in relation to boreholes in Tanduori and Kpaala. This illustrates

the direct practical consequences of such conflicts on everyday subsistence in the area.

5.7 Water Resources Conservation Approaches

Among all the communities, water conservation approaches were in place. Common to all the communities were the creation of buffer zones, planting of trees along the Black Volta River and the avoidance of tree cutting. The planting of trees is seen as an essential link to the conservation of natural resources (Manochon, 2010). Though these water resources conservation methods exist they are hardly adhered to in some of the communities. For instance in Bagri Zongo and Kpaala, farming activities are done closely to the river neglecting the buffer created. These have caused the loss of the vegetative cover resulting in erosion (Plate 5.7) with the silt ending up in the river (Plate 5.8). From interviews conducted and field observations, it was revealed that the Black Volta was the only source of water for their dry season farming and hence the failure on the part of the communities to observe the existence of the buffer zone created. On the contrary, the buffer zone was strictly observed in Tanduori and Wechiau. This success according to key informants has been achieved due to the presence of dugouts which serves as a source of water for dry season farming.

Again, vertiva grass has been planted around the catchment area of the dugouts. This is done to prevent erosion and consequently prevent the siltation of the dugouts. Also, farming activities are carried out only behind the embankments of the dugouts and this is strictly backed by the rules and regulations governing the use of the dugouts.

Plate 5. 7: Erosion along the Black Volta River

Plate 5. 8 : Siltation of the Black Volta River

5.8 Transboundary Issues and Concerns

Transboundary issues and concerns identified were mainly environmental degradation and transhumance. There also existed social ties between communities in Ghana and those in Burkina Faso.

5.8.1 Environmental Degradation

Within all the study communities issues of environmental degradation centred on bush fires, buffer zone depletion, river pollution, soil erosion and deforestation. Incidences of bush fires were recorded in all the five study communities. The bush fires came about at times as a result of the land preparation process to begin the new farming season. Though these land preparation activities are seen to be an important stage in the farming cycle, it is more often than not carried out without the provision of fire belts. As a result of this unguided action of farmers, the fires get out of hands catching up with the vegetation around resulting in bush burning (Plate 5.9). Another cause of bush fires in the study communities especially Kpaala and Dabagteng was due to the activities of poachers. The daily activities of the poachers often involve the use of fire which at times is unattended to catching up fire with close by vegetation.

Buffer zone depletion and soil erosion as environmental concerns were paramount in Bagri Zongo and Kpaala and also in Menuo a community on the Burkinabe side. Notwithstanding the fact that all the study communities have adopted the creation of buffer zones, this concept was hardly adhered to. In Bagri Zongo and Kpaala, farming activities were actively in progress at the banks of the Black Volta River. The same could be said for Menuo community in Burkina Faso. A respondent when asked why bank farming was predominant in Bagri Zongo reiterated that it was the only way they

can have access to water during the dry season for their farming activities. The practice of bank farming has its own repercussion which includes siltation and river pollution resulting from the application of agro- chemicals on farm lands. The resultant of the application of agro-chemicals was the deterioration of water quality which affected fish yield. Contrary to the observations made in Bagri Zongo and Kpaala, were the efforts being made by Tanduori and Dabagteng to observe the buffer zones in their respective communities. In Tanduori a buffer zone of about 20m is being observed. Tree planting activities (Plate 5.10) have already taken place through the efforts of the community in collaboration with development partners such as Global Water Initiative (GWI).

Plate 5.9: Bush burns in Dabagteng

Plate 5.10: Tree planting in buffer zone

The above enumerated environmental issues have also been identified by various studies (Andah and Gichuki, 2005; Barry *et al.*, 2005). Across all the study communities, focus group discussions revealed that recorded low agricultural productivity (yield), degradation of water quality and reduction in vegetative cover were all manifestations of soil degradation, erosion and environmental pollution. However, having mentioned the numerous environmental challenges that are faced by

the study communities, it is also important to look at the measures that are being implemented to curb these issues.

With regards to bush burning, all the communities have in place bushfire task force. The mandate of this task force is to manage and prevent indiscriminate bush burning. By-laws have also been instituted to check against indiscriminate bush burning and bank farming. All these interventions are well spelt out in each community's IWRM plan.

5.8.2 Transhumance

Transhumance involves the movement of cattle (Plate 5.11), sheep and people across national boundaries. With the exception of Dabagteng which prevented the activities of Fulani herdsmen in their community all the other study communities were faced with the issue of transhumance. Transhumance according to the communities was an issue of great concern. In Bagri Zongo for instance, there were reported cases of cattle and farm produce theft. According to key informants, as pastoralist pass through this community local herds men turn to steal cattle within the community and exchange them to prevent being caught. Some even steal the cattle and cross to Menuo, a community on the Burkinabe side where they exchange or sell to the nomads over there to avoid being caught. Another striking issue with the transhumance activity was the issue of rape. Key informant interviews revealed that there have been reported cases of rape of women and young girls in the Bagri Zongo community. These afore mentioned issues were confirmed when a Fulani herdsman gave the remarks that "*As for raping the women or sexually assaulting the women, some of our members might be involved, however, when it comes to stealing cattle, i am sure some of our members do it in collaboration with your people".*

Common to all the study communities are the issues of overgrazing, destruction of food crops as well as cutting down of economic trees such as sheanut to feed cattle. Transhumance as admitted by community leaders has generated a lot of tension which at times lead to conflict. This phenomenon according to Youkhana *et al.,* (2006) has increased as a result of dam construction and new water and land management structures.

In the communities efforts to curb the emerging issues associated with transhumance have proposed a number of solutions. In all the study communities, there was the suggestion that Fulani herdsmen should have heads, so that new Fulani who come into the communities report to them. The selected heads will be responsible for the actions and inactions of the Fulani herdsmen within each community. During focus group discussion sessions in Bagri Zongo, traditional leaders advocated that the selected heads of the Fulani herdsmen be integrated into the traditional governance system. Another proposal that was made in line to finding a permanent solution to the issue of transhumance is the adaptation of the agro-pastoralist approach. With this approach, farm residues (Plate 5.12) will be used to feed animals (cattle, sheep, goats, etc.) and by so doing avoid the movement of herds across national boundaries and consequently avert the problems that come along with it. However, notwithstanding the numerous interventions proposed, there have been calls for the need to see the Fulani herdsmen as business partners and for that matter accord them the needed respect. It is only through this way, that the indigenes of the study communities and the Fulani's can live harmoniously.

Plate 5.11: Evidence of transhumance

Plate 5.12: Cattle feeding on farm Residues

5.8.3 Transboundary Social Ties

The study has revealed that there is some level of interaction between riparian communities both on the Ghana side and Burkina side. These interactions include inter marriage, funeral attendance, farming, market attendance and fishing. A typical scenario that was recorded was the farming activities that occurred in both Bagri Zongo on Ghana side and Menuo on the Burkina side. Inhabitants of the two communities cross the Black Volta to cultivate farm lands in each other's community. Since they inter- marry the two riparian communities see themselves as one family and hence decides to farm together. Market activities were also found to be common to most of the riparian communities. For instance, the Tangasia market in Nadowli was attended by Dogbiripare, a community in Burkina Faso and Tanduori. Same was recorded for Zanbo market in Menuo a community in Burkina Faso where Bagri Zongo also had their trading activities. Inter marriage and funeral attendance as a means of social interaction also existed between Dabagteng in Ghana and Wizii and Kwan, all communities in Burkina Faso. Between Bagri Zongo and Menuo, fishing was observed to be one of their economic activities. However, it was identified that

the use of inappropriate fishing gear was an issue between the two communities. Fishermen in Bagri Zongo accused those of Menuo of using monophilament fishing net. According to these fishermen, the monophilament net has small openings which trap fingerlings. This has resulted in the reduction of fish catch over the years. Interestingly, the fishermen of Menuo also accused fishermen in Bagri Zongo of the same act they have been accused of.

In an attempt to settle this issue, fishermen groups in both communities agreed to lay down rules and regulations to govern their activities. Paramount among these checks was the banned on the use of inappropriate monophilament net. A fined that was determined by the two fishing groups in both communities was imposed on any member found defaulting the rules. Again, there are periodic sensitization programmes that are organized by the fisheries department of the Ministry of Food and Agriculture (MoFA) for the fishermen groups. These sensitization programmes are geared towards improving the sustenance of members of the group through the adoption and use of appropriate fishing methods and gears. A key informant interview revealed that though members of the fishermen group are sensitized on the use of appropriate fishing methods, getting access to these implements as a matter of fact poses a lot of challenge due to lack of funds.

6 CONCLUSIONS AND RECOMMENDATIONS

6.1 Conclusions

The conclusions drawn from the study are as presented below:

The potential for indigenous institutions to resolve water use conflicts at community level was clearly observed, with various local institutions providing effective fora to discuss the problems and explore alternatives. The indigenous management system was one of the unique strengths of community level water resource management in the study areas. Customary laws, rules and indigenous institutions prevalent in the study areas have strong religious, cultural, historical and social roots and are based on moral values and ethics. This suggests that the mobilization of local institutions and experiences is a key strategy in local level water resource management.

The presence of dugouts has contributed to the alleviation of river bank farming as were the cases recorded in Tanduori and Wechiau. Also the presence of the dugouts contributed immensely to the water availability in these communities thus the resultant increase in the number of inhabitants engaged in irrigation during the dry season.

The livelihood strategies of the study communities are solely dependent on water resources availability within these communities with crop and livestock production being the dominant livelihood. Rain-fed agriculture is predominant leaving inhabitants dormant for most part of the year due to the long dry season.

The principle of negotiation as a means of conflict resolution was effective as compared to the strict application of rules and regulations between parties. It promoted collective action and understanding between parties.

Codes of priority of water use, either written or unwritten, are relevant to deal with annual fluctuating supply. By prioritizing water uses, local water management distributes risk more equitably by allowing critical uses to have high priority in times of fluctuating supply.

6.2 Recommendations

In the light of the findings revealed in this study, it is recommended that:

1. Institutionalization of beneficent customs on water management in formal regulatory systems by means of bye-laws, legislative measures, instrument and statutes should be carried out.

2. The existing buffer zones created by the communities themselves should be strictly adhered to in order to prevent erosion and consequently siltation of the Black Volta River.

3. In order to promote and strengthen cooperation among the various water users, the existing rules and regulations pertaining to each water use type should be made known to the community inhabitants and must be observed as such.

4. As a matter of urgency, the government through the appropriate district assemblies should provide dugouts for the other three communities without

dugouts. This will ensure the availability of water for all year round farming and by so doing the sustainability of the various livelihood strategies, more especially crop and livestock production will be guaranteed.

REFERENCES

Agyenim, B. J. (2011): Investigating Institutional arrangement for Integrated Water Resources Management in developing countries: The case of the White Volta Basin, Ghana. PhD Dissertation. Vrije Universiteit

Ampomah, B., Adjei, B. and Youkhana,E. (2008): The Transboundary Water Resources Management Regime of the Volta Basin.http://www.zef.de/fileadmin/webfiles/downloads/zef_wp/wp28.pdf. Accessed: 26th July, 2011.

Ampomah, B. (2008): Lessons from emerging conflict resolution mechanisms in the volta Basin. 33rd WEDC International Conference. Accra, 7-11 April, 2008

Andah, W. and Gichuki, F. (2005): Volta River Basin: Enhancing Agricultural Water Productivity through Strategic Research. Baseline Report No. 8, CGIAR Challenge Program on Water and Food.http://www.water-mwrwh.com/downloads/CPWF Volta Basin Profile20.pdf. Accessed: 28th July 2011

Andah, E. I., van de Giesen, N. and Biney, C. A. (2003): Water, climate, food, and environment in the Volta Basin. Adaptation strategies to changing environments. Contribution to the ADAPT project. http://www.weap21.org/downloads/ADAPTVolta.pdf: Accessed 18th November, 2011

Arriens, W. L. and Alejandrino, A. (2004): Doing Things Better; Effective Development and Management of Water Resources Require the Consultation and Participation of all Stakeholders—With Government Leading the way. Asian Development Bank

Asamoah, K. and Kortatsi, B. K. (1997): Rural Water Supply. Ghana Water Resources Management study. Information Building Block Study 1997 pp 1-37.

Bambangi, S. (2010): Literature Review on the Black Volta River Basin in Ghana. Global Water Initiative, Ghana

Barry, B., Obuobie, E., Andreini M., Andah, W. and Pluquet M. (2005): "The Volta River basin: Comprehensive Assessment of Water Management in Agriculture". Comparative study of river basin development and management :www.iwmi.cgiar.org/Assessment/files_news/research_projects/River_Basin.Accessed 24th March, 2011

Biswas, A. K. (2004): From Mar del Plata to Kyoto: Analysis of Water Policy dialogue, Global Environmental Change, 14, pp81-88, Elsevier Science Ltd.

Biswas, A. K. (2001): Management of International Waters: Opportunities and Constraints, in Sustainable Development of the Ganges-Brahmaputra-Meghna Basins, A.K. Biswas and J.I. Uitto (eds.), United Nations University Press, Tokyo, pp. 1-16

Bustamante, R., Butterworth, J., Flierman, M., Herbas, D., den Hollander, M., van der Meer, S., Ravenstijn, P., Reynaga, M. and Zurita, G. (2004). Livelihoods in conflict: disputes over water for household-level productive uses in Tarata, Bolivia:www.irc.nl: Accessed 11th November, 2011

Carius, A., Dabelko, D. G. and Wolf, A. T. (2004): Water, Conflict and Cooperation, Policy Briefing Paper for United Nations and Global Security Initiative

Chambers, R and Conway, G. (1991). Sustainable rural livelihoods: Practical Concepts for the 21st century IDS discussion paper; No 296. Institute of Development Studies

Chou, S., Russ, B. and Anne, W.(1997): Water Scarcity in River Basins as a Security Problem, Woodrow Wilson International Centre for Scholars, Environmental change and Security Project, Washington DC, pp. 96-105

Falkenmark, M. (1989): The Massive Water Scarcity now threatening Africa: why isn't it being addressed, Ambio **18** (2): 112-118

FAO (2008): Legal papers online No. 76: http://www.fao.org/legal/prs-ol/lpo76.pdf: Accessed: 19th October 2011
FAO (1988): Soils map of the world: revised legend. Food and Agriculture Organization of the United Nations, Rome pp119.

GEF-UNEP (2002): Volta River Basin. Preliminary Transboundary Diagnostic Analysis. Final Report.

Ghana Statistical Service (2010): 2010 population and housing census

Ghana Statistical Service (2005): Analysis of district data and implication for planning: Upper West Region

Gleick, P. H. (2000): The Changing Water Paradigm: A Look at Twenty-first Century Water Resources Development, Water International **25** (1): 127-138

Gleick, P. H. (1998): The World's water 1998-1999. Biennial Report on freshwater resources. Washington DC: Island Press, p217

Global water partnership (2000): Integrated water resources management, Technical Advisory committee Background paper No.4, Stockholm.

Huang, Y., Li, Y. P., Chen, X., Bao, A. M and Zhon, M. (2010): "Simulation-based Optimization Method for Water Resources Management in Tarim River Basin, China" Procedia Environmental Sciences 2: 1451-1460

ICWE, International Conference on Water and Environment (1992): The Dublin Statement on Water and Sustainable Development January 31, 1992, Dublin, Ireland, A/RES/2994:http://www.unesco.org/science/waterday2000/dublin.htm. Accessed: 15th November, 2011

IUCN (2003): Customary Laws: Governing natural resources management in the northern areas. http://data.iucn.org/dbtw-wpd/edocs/2003-10 pdf. Accessed: 19th October, 2011

Jaspers F. G. W. (2003): Institutional arrangements for integrated river basin management. In water policy 5. Pp77-90

Katerere, J. and Van der Zaag, P. (2004). Untying the Knot of Silence": Making Water Policy and Law Responsive to Local Normative Systems: http://web.africa.ufl.edu/asq/v5/v5i3a7.htm : Accessed 3rd November ,2011

Lautze, J., Giordano, M. and Borghese, M. (2005): Driving forces behind African transboundary water law: internal, external and implications: International workshop on African Water Laws: Plural Legislative Frameworks for Rural Water Management in Africa, 26-28 January 2005, Johannesburg, South Africa.

MacQuarrie, P. R., Viriyasakultorn, V. and Wolf, A. T. (2008): Promoting Cooperation in the Mekong Region through Water Conflict Management, Regional Collaboration, and Capacity Building. GMSARN International Journal Vol. 2, pp175 – 184

Maganga, F. P. (1998). Indigenous Knowledge and Irrigation Development in Tanzania: Experiences From Msanzi, Nyeregete and Musa Mwijanga farmer-managed irrigation schemes. Paper presented at the Scandinavian Seminar College on African Perspectives on Policies and Practices Supporting Sustainable Development, Harare, October, 1998

Manochon, A. M. (2010): Indigenous Management of Water Resources in Bontoc Mountain Province, Philippines. 4th Asian Rural Sociology Association (ARSA) International Conference.

Merriam-Webster Online (2011):http://www.webster.com. Accessed: 19th October, 2011

Ministry of Water Resources, Works and Housing, Ghana (1998).Water Resources Management (WARM) study –information building block. Accra, Ghana

MoFA (2011): Profile of Upper West Region
Moniod, F., Pouyaud, B. and Sechet, P. (1977): Le Bassin du Fleuve Volta. Monographies Hydrologiques Orstom, No. 5. Paris.

Narendra, P. S., Torbjorn, D., Gilgan-Hunt, E., Grey, D., Okaru, V. and Rothberg, D. (1996): African Water Resources; Challenges and Opportunities for Sustainable Development. The International Bank for Reconstruction and development/ The world bank

Nompumelelo, T. B. (2001). Water Resources Management: The Challenge of Integration in the implementation of Zimbabwe's New Water Policy: Case Study of The Catchment Level Institutions Surrounding The Pungwe-Mutare Water Supply Project. University of The Western Cape, P/Bag X17, Bellville 7535, South Africa.

Ohlsson, L. (2000): Water conflicts and social resource scarcity. Journal of Physics and Chemistry of the Earth, Part B: Hydrology, Oceans and Atmosphere **25** (3): 213-220.

Reba, P. (2003): Sectoral Trends In The Water Sector (Technology, Policy And Poverty) In South Asia. By Programme Coordinator Global Water partnership South Asia. South Asia Conference on Technologies for Poverty Reduction, New Delhi, 10 - 11 October, 2003

Roling, N. and Seegers, T. (1991): Fitting AKIS to the Technology. In: Campilan, D.M. Sustainable Agriculture – A Knowledge Systems View Paper presented at the International Symposium on Indigenous Knowledge and Development, September 20-26, IIRR, Silang Cavite, Philippines

Sarpong, G. A. (undated): Customary Water Laws and Practices in Ghana:http://www.fao.org/legal/advserv/FAOIUCNcs/Ghana.pdf. Accessed: 21st October, 2011

Uitto, I. J and Duda, M. A. (2002): Management of transboundary water resources: Lessons from international cooperation for conflict prevention. Geographical Journal **168** (4): 365-378

UN (2000): Millennium Development Goals: http://www.un.org/millenniumgoals Accessed 5th October, 2011

Van Edig, A., Stefanie, E. and Wolfram, L. (2003): Ghana's water institutions in the process of reform: from the international to the local level.http://www.glowa-volta.de/publications/printed/van_edig_etal_2003. pdf: Accessed: 19th January, 2012

Van Der Bleik, J. and Van Veldhuisen, L. (1993): Developing Tools Together: Report of a Study on the Role of Participation in the Development of Tools, Equipment and Techniques in Appropriate Technology Programmes GATE/ETC, Eschborn/Leusden

Van De Giesen, N., Andreini, M., Van Edig, A. and Vlek, P. (2001): Regional Management of Water Resources; Proceedings of a symposium held during the Sixth IAHS Scientific Assembly at Maastricht, The Netherlands, July 2001. IAHS Publ. no. 268,

Van der Hoeck, W. (2001): 2020 Focus 9; Overcoming Water Scarcity and Quality Constraints, Brief 5 of 14, Water And Rural Livelihoods. International Water Management Institute, Colombo, Sri Lanka.

Van Der Irna, M. and Hildering, A. (2005): "Water: Cause for Conflict or Co-operation", Journal on Science and World Affairs 1(2), p134

Van Koppen, B., Sokile, C. S., Hatibu, N., Lankford, B. A., Mahoo, H. and Yanda, P. Z. (2004): Formal Water Rights in Rural Tanzania: Deepening the Dichotomy? Colombo, Sri-Lanka; International Water Management Institute

Warner, M. and Jones, P. (1998): 'Assessing the need to manage conflict in community-based natural resource projects'. Natural Resource Perspectives

Warren, D. M., Slikkerveer, L. J. and Brokensha, D. (1995): The Cultural Dimension of Development: Indigenous Knowledge Systems Intermediate Technology Publications Ltd (ITP), London

WHO (2012): Progress Report on Drinking water and Sanitation http://www.who.int/water_sanitation_health/publications/2012/jmp_report/en/index.html Accessed: 10th May 2012

Wolf, A. T. (2007). Shared Waters: Conflict and Cooperation. Annual Review of Environment and Resources 32: 3.1-3.29:http://environ.annualreviews.org Accessed:1st August 2011

Wolf, A. T., Yoffe, S. B. and Giordano, M. (2003): International waters: identifying basins at risk. Water Policy **5**(1): 29–60.

Wolf, A. T. (2002): Indigenous approaches to water conflict negotiations and implications for international waters, in: International Negotiation: A journal of theory and practice. Volume **5**(2):

World Bank (2000): What is Indigenous Knowledge? http://www.worldbank.org/afr/ik/basic.htm: Accessed: 18th October, 2011

World Bank (1998): Indigenous Knowledge for Development: A Framework For Action: http://www.worldbank.org/afr/ik/ikrept.pdf.Accessed: 19th October, 2011

Youkhana, E., Rodgers, C. and Korth O. (2006): Extended Abstract for the III International Symposium on Transboundary Water Management. Transboundary Water Management in the Volta Basin.

APPENDIX

Appendix A: Key Informants Questionnaire

District Name…….

Community Name……. Questionnaire No……

Geographic Coordinate…….. Date of interview……..

A. Introductory:

1. What is the general rainfall pattern in your area?

   ……

2. What would you say about the availability of water in your area?

   ……

B. Water resources management

1. How are the following issues pertaining to water resources addressed?

a. Water allocation

……

b. Resolution of water conflicts

……

c. Water resources protection and management

……

d. Infrastructure management.

……

e. Prevention of water pollution (ensuring the right water quality)

……

C. The Role of Traditional leaders:

1. Identify any traditional water management practices in this village. (Practices that you carry out without interference from the government or any other organization)

……

2. What is/was the traditional institutional set-up?

……

3. Were/are these practices effective in ensuring cooperation among various water users?

……

4. Do you think these traditional practices of water management were/are sustainable for effective water resources management?

……

6. What role was/is played by the traditional leaders in the management of water resources?

a. The Chief

b. The Assembly man

c. The Tindana

d. Spirit medium

7. Were/are there any clashes in these roles? If yes what are the clashes.

……

8. What was/is the role of women and the youth in water management practices?

……

E. Conservation:

1. Is there any form of conservation of water resources carried out traditionally? (water sources, tree planting, wetland conservation?) Explain how?

Lastly: What do you think is the general effect of the modern methods on the people's livelihoods? Have they changed for the better or worse?

Appendix B: Households Questionnaire

District Name…….

Community Name……. Questionnaire No……

Geographic Coordinate…….. Date of interview……..

General Information

A1. Household information:

1. Gender: 1. Male

2. Female

2. Age bracket

1. below 15yrs:

2. 15 – 30 yrs

3. 31- 45yrs

4. 46 - 60yrs

5. Above 60yrs

3. Educational level:

1. Pre-school

2. Primary

3. Middle/JHS

4. Secondary school

5. Tertiary

6. No school

4. Income level per month

[ ] Under GH¢ 20

[ ] GH¢ (20-50)

[ ] GH¢ (51-100)

[ ] above GH¢ 100

5. Religious affiliation:

[ ] Christian

[ ] Islam

[ ] Traditionalist

[ ] No religion

[ ] Other, Specify…….

A. Water resources

A1. What is the general rainfall pattern in this village?

1. Regular (give months)……...

2. Irregular

A2. Does the rainfall always come at the same time of the year?

1. Yes

2. No

A3. On average, is the amount of rainfall usually the same every year?

1. Yes

2. No

A4. What would you say about the availability of water in your village?

1. Scarce

2. Enough

3. Abundant

A5. How does water scarcity affect the following?

Livestock	Crop production
Livestock die [ ]	crops die [ ]
Less livestock produced [ ]	Less crops produced [ ]
Livestock transported to other areas [ ]	Other, specify [ ]

A6. What are the relevant authorities concerning water resources management (Whom do you address your water related issues to?)

1. The chief

2. The Assemblyman

3. WUA Executives

4. Others, specify……..

B. Livelihoods

B1. What are the major sources of livelihoods for this household (please rank starting with main source of livelihood)?

Source of livelihood	Ranking: 1-Highest, 2-High, 3-moderate,4-small,5- very small
Crop production	
Livestock production	
Trading (specify)……..	
Casual labourer	
Other(specify)	

B2. Do you produce enough food in your household for all the members for the whole year?

1. Yes

2. No

If no, why not?

……

B3. Are these practices effective in sustaining the livelihoods of the rural people (that is, is the income at household level sustainable)?

1. Yes

2. No

If no, why not? ……..

B4. In this village, what livelihood strategy (ies) is/are most practiced?

[ ] Crop production

[ ] Livestock production

[ ] Casual labourers (where?) ……

[ ] Trading (specify) ……..……

[ ] Others (specify)……

B5. What type of agriculture is mostly practiced in this village (please rank, starting with the most practiced)

Agricultural Type	Ranking: 1-Highest, 2-Higher, 3-High
Rainfed	
Irrigated	
Both	

B6. Have there been any noticeable changes in these practices over time?

1. Yes

2. No

B7. What are the changes that have occurred?

1. More people tending to crop production

2. More people tending to livestock production

3. More people practicing both

4. People taking up new livelihood strategies (specify) ……

B8. What are the reasons for these changes?

1. General increase in water resources
2. General decrease in water resources
3. Introduction of modern methods (specify) ……
4. Other (specify) ……

C. Types of water uses and priorities

C.1 Domestic use

C1.1. Identify your sources of water for domestic use (drinking, cooking and washing) (Rank, starting with source most used for domestic)

1. Dam
2. Borehole
3. Well: Protected…… Unprotected…….
4. Rain
5. Other (specify) …….

C1.2. What is the situation of access to water for domestic purposes; proximity to water source:

1. Less than 1 km
2. 1 - 3kms
3. 3 – 6kms
4. More than 6km

C1.3. How reliable is your source of water in terms of quantity?

1. All year round
2. 6 months
3. 3 months
4. Other (specify) …….

C1.4. Are there any rules pertaining access, abstraction and use (that is allocation) of Domestic water?

1. Yes
2. No

If yes, what are these rules?

……

C1.5.Who sets these rules?

1. The community
2. The traditional leaders
3. Others (specify)……

C1.6. Who handles water-related conflicts concerning domestic water use(especially in times of scarcity)?

1. The Traditional Leaders
2. The community
3. Other (Specify) ……
4. Both traditional leaders and the community

C.2 Livestock watering

C2.1. Identify your sources of water for livestock watering (rank using 1, 2, 3…)

Source of water	Ranking: 1-Highest, 2-Higher, 3-High,4-moderate
Dam	
Borehole	
Well	
Other (Specify)	

C2.2.What is the situation of access to water for livestock watering; proximity to water source:

1. Less than 1 km

2.1 - 3kms

3.3 – 6kms

4. More than 6km

C2.3.How reliable is your source of water in terms of quantity

1. All year round

2. 6 months

3. 3 months

4. Other (specify) …….

C2.4.Are there any rules pertaining access, abstraction and use of water for Livestock watering?

1. Yes

2. No

If yes, what are these rules?

……

C2.5.Who sets these rules?

1. The community

2. The traditional leaders

3. Others(specify)……

C2.6. Who handles water-related problems concerning water for livestock watering (especially in times of scarcity)?

1. The Traditional Leaders

5. Other (Specify) ……

C.3. Small garden watering

C2.1. Identify your sources of water for small garden watering (rank using 1, 2, 3…)

Source of water	Ranking: 1-Highest, 2-Higher, 3-High,4-moderate
Dam	
Borehole	
Well	
Other (Specify)	

C2.2.What is the situation of access to water for small garden watering; proximity to water source:

1. Less than 1 km
2. 1 - 3kms
3. 3 – 6kms
4. More than 6km

C2.3. How reliable is your source of water in terms of quantity

1. All year round
2. 6 months
3. 3 months
4. Other (specify) …….

C2.4.Are there any rules pertaining access, abstraction and use of water for Small garden watering?

1. Yes
2. No

If yes, what are these rules?

……

C2.5.Who sets these rules?

1. The community
2. The traditional leaders

3. Others (specify)……

C2.6. Who handles water-related problems concerning small garden watering (especially in times of scarcity)?

1. The Traditional Leaders

2. The Community

3. Other (Specify) ……

D. Water allocation

D1. How is water use prioritized in times of scarcity? (use 1, 2, 3 .. where 1 = first priority)

a. Drinking and cooking

b. Gardening

c. Livestock watering

d. Irrigation

e. Others (specify) …….

D2. Who gives priority to water access (for example livestock watering or drinking water) in times of scarcity?

1. The Traditional Leaders

2. The community

3. Other (Specify) ……

D3. Who handle matters concerning competition over water resources in this village?

1. Traditional leaders

2. WATSANS

3. Other (specify) ……

D4. Are there cases when people are denied access to the water?

1. Yes

2. No

If yes, what are the reasons for this denial?

……

D5. Are there any fees/contributions that villagers/community currently pay to access water

1. Yes (Specify) …….

2. No

E. Roles and Responsibilities

E1. Who is responsible for the following regarding your water resources?

a. For dams

	Day-to-day operation	Infrastructure Maintenance	Ensuring right water quality	Conflict Management
Traditional leaders				
WATSAN				
Community				
Other(specify)				

b. Management of boreholes and wells

	Day-to-day operation	Infrastructure Maintenance	Ensuring right water quality	Conflict Management
Traditional leaders				
WATSAN				
Community				
Other(specify)				

E2. What role is played by the following on issues concerning water resources in your village?

a. The Chief …….

b. The unit committee……

c. The assembly man …….

d. WATSAN

e. The community as a whole ……..

E3.Are there any clashes in these roles?

1. Yes

2. No

If yes, what are these clashes?

……..

E4. Are the leaders paid to do their roles?

1. Yes

2. No

If yes, who pays these traditional leaders? (please tick)

	chief	Assemblyman	WATSAN	
Government				
Community fees				
Other(specify)				

E5. What is the role of women and the youth in water resources management? (please tick)

	Women	Youth
Collecting water for domestic purposes		
Day-to-day operation		
Infrastructure maintenance		
Other(specify)		

E6. Who designates specific areas for washing, watering of animals, drawing of drinking water?

1. Government officials

2. Chief

3. Assemblyman

4. Unit committee

5. The community

6. Other (specify)……

E7. What punishment is given to persons caught polluting the water?

a. Fined (specify) …….

b. Denied access to water

c. Other (specify) …….

E8. What is the punishment for those who don't contribute? Are they?

a. Denied access to water

b. Fined (specify)……

c. Other (specify) ……

F. General Water Management practices

F.1 Traditional/Indigenous water management

1. Identify any traditional water management practices in your area (anything that you do without the intervention of any external organization)

……

2. Who is responsible for protecting water sources traditionally?

1. Chief
2. Assemblyman
3. Unit committee
4. The community
5. Other (specify)……

3. Who is responsible for water technology management traditionally?

1. Chief
2. Assemblyman
3. Unit committee

4. The community

5. Other (specify)……

4. Who is responsible for ensuring good water quality?

1. Chief

2. Assemblyman

3. Unit committee

4. The community

5. Other (specify)……

5. How is ownership of water resources under traditional systems established?

1. by digging a canal

2. by proximity to a source

3. Application (specify whom to) ……..……

4. Other (specify)…….. ……..