UNIVERSITY OF CAPE COAST

EFFECTS OF THE AKOSOMBO AND KPONG POWER SCHEMES ON SIX SELECTED MAFI-COMMUNITIES IN THE VOLTA REGION

BY

PROSPER KWAMI AGBENYO

DISSERTATION SUBMITTED TO THE INSTITUTE FOR DEVELOPMENT STUDIES OF THE FACULTY OF SOCIAL SCIENCES, UNIVERSITY OF CAPE COAST, IN PARTIAL FULFILMENT OF THE REQUIREMENTS FOR AWARD OF MASTER OF ARTS DEGREE IN ENVIRONMENTAL MANAGEMENT AND POLICY

SEPTEMBER 2009

DECLARATION

Candidate's Declaration

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

Candidate's Signature:…… Date:……...

Name: Prosper Kwami Agbenyo

Supervisor's Declaration

I hereby declare that the preparation and presentation of the dissertation were supervised in accordance with the guidelines on supervision of dissertation laid down by the University of Cape Coast.

Supervisor's Signature:…… Date:……..

Name: Dr. Patrick Agbesinyale

ABSTRACT

This study sought to assess the effects of Akosombo and Kpong hydroelectric power projects on the lives of people and the natural environment in six Mafi communities within the Lower Volta Basin in the Volta Region.

Systematic sampling technique was adopted to select one hundred and twenty (120) resident household heads for interview in the six study communities. Questionnaires were also administered to Environment and Community Development Officers of Volta River Authority (VRA) and Environmental Protection Agency (EPA) as well as the North Tongu District (NTD) Planning Officer who were purposively sampled.

The study found that the hydropower-projects on the Volta River have brought untold hardship onto the lives of the people, retarded the development of the communities and fueled dislocation of established family units and socio-cultural values in the study area. The study further revealed that the schemes have negatively affected the natural environment directly and also influenced human-induced environmental degradation in the study area. The study showed farming, firewood and charcoal burning and out-migration among a number of coping measures adopted by people in the study communities.

Among recommendations made are as follows. The North Tongu District Assembly and VRA should promote aqua-culture and an integrated agri-business, and as well facilitate the removal and control of the growth of waterweeds on River Volta and its tributaries in the lower Volta basin including study area.

ACKNOWLEDGEMENTS

The successful completion of this study has been possible because of the co-operation and assistance that I received from many individuals and institutions. My sincere gratitude goes to my supervisor, Dr. Patrick Agbesinyale for painstakingly reading the script and offering useful suggestions and advice during the time of supervision. I am sincerely, thankful to the Chiefs, Headmen, Opinion leaders and all residents, particularly, household heads in the study communities for their co-operation and assistance.

I wish to express my thanks to the North Tongu District (NTD) Planning Officer, the Director-Corporate Service of Volta River Authority (VRA) and respondents from Environmental Protection Agency (EPA) for their co-operation and responses. Finally, I am grateful to authors of books, and contributors to magazines, journals, websites and Encarta that I found useful for this study.

DEDICATION

To my family and close associates.

TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

ACRONYMS

ECG	Electricity Company of Ghana
EPA	Environmental Protection Agency
MDA	Ministries, Departments and Agencies
NTD	North Tongu District
NTDHD	North Tongu District Health Directorate
VRA	Volta River Authority
UNEP	United Nations Environment Programme

CHAPTER ONE

INTRODUCTION

Background to the study

Developments in most parts of Europe, North America, Asia and Africa have been stimulated by hydroelectric power schemes. The Rjukan hydroelectric power scheme in Norway generates 7 million KW of electricity from Lakes Mosvann and Tinnsjo in the Mana Valley to meet domestic energy supplies required for lighting, heating and cooking, as well as providing energy for powering manufacturing industries and railways (Bunnett and Okunrotifa, 1986). The Kitimat hydroelectric power scheme on River Nechako in USA supplies electricity to the aluminium smelting industry in Kitimat (Bunnett and Okunrotifa, 1986). In Africa, for example, the Owen Fall hydroelectric power scheme in Uganda produces 130MW electricity to meet domestic and industrial energy needs in Uganda and in three major cities (such as Kisumu, Nakuru and Nairobi) in Kenya. Industrial growth was greatly stimulated in Uganda by hydroelectricity and Jinja, Tororo, Kampala, Port Bell and Mbale in particular have become the industrial hubs in Uganda (Bunnett & Okunrotifa, 1986).

Accumulated water in hydroelectric power scheme dams are used for irrigation farming. The Snowy Mountain hydroelectric power scheme provides irrigation water for about 500000 hectares of farmland for fruit cultivation in the

Murrumbidgee and Murray basins in Australia (Bunnett & Okunrotifa, 1986). The cropped area in Egypt has increased from a pre-dam area of 22million hectares to a present total of 27million hectares after the Aswan High Dam was constructed in 1968 (Pritchard, 1988).

Hydroelectric power scheme lakes are now good fishing grounds in the world. The culture of freshwater fishing is important in China, and the government has encouraged fishing in reservoirs along the middle and lower Yangtze Valley and the Pearl River. The annual fish catch from freshwater sources including hydroelectric scheme lakes in China in the 1990s was about 7 million tones (Encarta Encyclopedia Standard, 2005**)**. The Kainji hydroelectric scheme lake serves as a major source of fish in Nigeria. Over 6000 fishermen are directly engage in fishing on the Kainji Lake (Pritchard, 1988).

Hydroelectric power schemes lakes are also used to facilitate efficient inland water transport systems. The Champlain Lake in USA for example, is linked to the Champlain Canal which is part of the New York State Barge Canal system, connected to the Hudson River and the St Lawrence River in Quebec, by the Richelieu River and the Chambly Canal. The principal cities that benefit from lake transport on the lakeshore are Burlington, Vermont, Plattsburgh, Crown Point and New York (Encarta Encyclopedia standard, 2005).

Other benefits derived from hydroelectric power schemes all over the world are, flood control in lower river valleys, soil conservation, supply of potable water for domestic and industrial purposes and promotion of recreation and tourism in the river basin. The Tennesee Valley hydroelectric power scheme

was used to control annual flooding and to facilitate soil conservation in the river basin and as well provide potable water for domestic and industrial uses in many towns and cities (Bunnett & Okunrotifa, 1986). Kariba Dam built across River Zambezi on the border between Zambia and Zimbabwe, was constructed as a joint venture between the two countries to provide them both with a vast hydroelectric generating facility and to reduce the level of damage caused to natural vegetation, wildlife and people in Mozambique and Zimbabwe by seasonal floods (Pritchard, 1988).

The desire to harness water resources for energy production in Ghana led to the development of two hydroelectric power schemes on the Volta River at Akosombo between 1959 and 1966, and Kpong in Eastern Region, and a third scheme being developed at Bui in Brong Ahafo Region on the Black Volta. Akosombo dam is an earth-filled dam, 640 m (2,100 ft) in length and 74 m (243 ft) above the lower water level. The reservoir, Lake Volta, has an area of 8,480 sq km (3,273 sq mi) and a length of 400 km (249 mi). The dam's installed hydroelectric power generating capacity is 912 MW (Amankwaa, 2002).

The completion of the Kpong dam with a capacity of 160MW in 1981 has raised the power generation capacity of the hydroelectric power projects on the Volta River to 1,072MW (Amankwaa, 2002). The hydroelectric power schemes provide electricity for most of Ghana’s main towns and cities, such as Accra, Tema, Kumasi, Tamale etc for both domestic and industrial uses. Availability of cheap hydroelectric power supplies has facilitated development of a number of industries including, aluminium smelting and its subsidiary industries; iron and

steel industries; textile and cocoa processing industries in Accra, Tema and Kumasi in particularly and southern Ghana in general (Amankwaa, 2002).

The accumulated water in the two dams is also used as inland water transportation systems, for fishing, irrigation farming, production of potable water, and as tourism attractions in Ghana. These uses of the dams benefit all segments of Ghanaian society, in one way or the other, irrespective of ones location in the country (Amankwaa, 2002).

The hydroelectric power schemes also serve as a source of foreign exchange earnings for Ghana. Ghana receives about 9% of her foreign exchange earnings from exportation of hydroelectric power to Togo and Benin as well as the border towns in Burkina Faso. The nation uses the foreign exchange to import goods and services that are not produced locally in Ghana. Examples of such goods and services are the electrical equipment imported by Volta River Authority (VRA) and Electricity Company of Ghana (ECG), vehicles and expertise from countries like China, India, USA and UK (Amankwaa, 2002).

Many people have been offered employment as result of the hydroelectric power schemes on the Volta River at Akosombo and Kpong. While VRA and ECG employ over 7000 people, fishing engages over 25000 people on the Volta Lake. Other subsidiary activities such as electrical, electronic repair and metal works offer jobs for a sizeable number of people in Ghana (Amankwaa, 2002).

A hydroelectric power scheme involves construction of concrete barrier (dam) across streams or rivers to impound water and raise its level behind the barrier for many purposes. The most common reasons for building dams are to

concentrate the natural fall of a river at a given site, thus making it possible to generate electricity (Hydro-Power); to direct water from rivers into canals for irrigation and water-supply systems; to increase river depths for navigational purposes; to control water flow during times of flood and drought; and to create artificial lakes for recreational uses (Encarta Encyclopedia Standard, 2005).

Many dams fulfill several of these functions. For example, the Glen Canyon Dam on river Colorado (USA), built between 1957 and 1964, is 216 m (710 ft) high and 475 m (1,560 ft) long with a total power-generating capacity of 1,042,000 kW, and provides the majority of the electrical energy generated by the Colorado River Storage Project (http://en.Wikipedia.org/Wiki/Glen-Canyon-Dam). Norris Dam on River Clinch (USA) provides electricity, controls flooding, increases the region's water supply, and provides lakes for recreational purposes (Encarta encyclopedia Standard, 2005). The Daniel Johnson Dam on River Manicouagan (Canada), completed in 1968, is a very large multiple-arch buttress dam with a length of 1,306 m (4,284 ft) and a height of 214 (703 ft) (Encarta Encyclopedia Standard, 2005).

In Asia, the following are examples of hydroelectric scheme dams. Tarbela Dam, completed in 1974 on the Indus River in Pakistan, is 148 m (485 ft) high and 2,743 m (9,000 ft) long. It contains 126,151,570 cu m (165 million cu yd) of earth and rock in the main dam, the largest volume ever used in an embankment dam. The project, including hydroelectric-power facilities, cost more than $1 billion (http://en.Wikipedia.org/Wiki/Tarbela_Dam). The massive Three Gorges hydroelectric scheme on the Yangtze River in China will produce a dam 2

km (1.2 mi) long and 100 m (328 ft) high. Bigger than anything built in China since the Great Wall, the reservoir will stretch 600 km (360 mi) upstream, making it the world's longest reservoir. The Three Gorges will supply power to Shanghai and provide power for the development of the upper Yangtze River basin. It is also designed to protect some 10 million people downstream from widespread flooding in a plain that supplies two-thirds of China's rice. It will also open the river above the gorges to shipping. The dam will plug the Xiling Gorge and the reservoir will displace 1.2 million people (http://en.Wikipedia.org/Wiki/Three_ Gorges_Dam).

Africa also has a number of hydroelectric schemes. Aswān High Dam across River Nile in Egypt impounds one of the largest reservoirs in the world. Construction of the mammoth dam began in 1960, and was completed by mid-1968 at a total cost estimated at more than $1 billion. The High Dam has an embankment 111 m (365 ft) high that extends almost 1,000 m (3,280 ft) across the river. The artificial lake created by the dam covers an area more than 480 km (300 mi) long and 16 km (10 mi) wide. The project has a generating capacity of 2,100 megawatts of electricity (Pritchard, 1988).

Kainji Dam also in Africa was built between 1964 and 1968 on the River Niger in Nigeria. It is an earth dam with a 66 m (215 ft) high concrete centre structure housing hydroelectric turbines. With a total length of 10 km (6.333 mi), including a saddle dam over a tributary valley, it may well be the longest dam in the world. Kainji Reservoir formed behind the dam is 135 km (84 mi) long, about 30 km (19 mi) across at its widest, and covers 1,250 sq km (480 sq mi). About 92

per cent of its storage capacity can be drawn down for power generation. The dam is provided with a single lock chamber capable of lifting barges 49 m (160 ft). Traditional irrigation farming has revived around the lake, now based on small motor pumps rather than hand methods of lifting water. Dugout canoes have given way to plank boats as fisherfolk provide fish for the domestic economy (Iwena, 1996).

Statement of the problem

Hydropower schemes, even though bring a number of benefits to the individuals in particular and the national economy in general, there are some negative effects of the schemes on the socio-economic lives of the people and the natural environment in the river basins. A number of communities within the Mafi traditional area in the North Tongu District (N.T.D) of the Volta Region have been affected in the lower Volta basin by the two dams constructed on the Volta River at Akosombo (completed in 1963) and Kpong (completed in 1981) for hydropower schemes in Ghana.

Since the construction of the two dams, fishing which was the main economic activity of the people of Mafi traditional area along the Volta River has collapsed. For example, oyster, shrimps and tilapia which were in abundance in the area before the construction of the dams are no longer available. The Member of Parliament for the Area was quoted as saying that the creation of Akosombo and Kpong dams had affected the flow of the Volta River and for that reason restrained the breeding of clams or oyster, popularly called “Afoli” or “Adodi”,

which was the main source of income for the majority of the people in the area (Daily graphic, July 19, 2007: p16).

Waterweeds such as Utricularia Spp, Eichhornia Crassipes, Moss, Panicum Maxima and Scirpus Cubensis (See Figure.2 in Appendix I) that were not in existence in the lower Volta Basin before the construction of the two dams now colonise parts of the river in the basin where Mafi communities are located.

Water transportation downstream which used to be a reliable means of transportation and a viable economic activity for the people has been affected by waterweeds and shallow water level, particularly during the dry season. Floating vegetation below the dam has covered berthing points along the banks of the river. The water in the lower valley also becomes so shallow near the banks such that modals such as ferries, launch, large boats and canoes find it difficult to sail on the river near the banks and to berth.

Another problem as noted in the 'Profile of North Tongu District (N.T.D)' (2005) is that water borne diseases like bilharzias are prevalent, while malaria is the number one killer disease in the district due to large mosquito population in the area. The communities that were heavily populated before the 1960s are now almost deserted. They become alive only when there is annual Hogbetsotso festival attracting both citizens and non citizens from far and near.

The banks of the Volta River in the lower basin are experiencing serious deforestation and erosion as a result of wood harvesting and farming. The banks of the river were covered with forests before the 1970. However, observations made during a visit to the communities (between March 15-18, 2008) indicated

that the vegetative cover of the banks today could be described as grassland with interspersed bare lands at some sections.

This study therefore seeks to assess the effects of the two hydroelectric power schemes at Akosombo and Kpong on the socio-economic lives of people and the environment in six selected Mafi communities **(**namely Agbenyorkorpe, Aklamador, Aloryi, Dokpo, Dugame and Devime**)** in the lower Volta basin in N.T.D. of the Volta Region.

Objectives of the study

The goal of the study is to analyse the effects of the two hydroelectric power schemes at Akosombo and Kpong on the socio-economic lives of the people and the environment in six selected Mafi communities in the lower Volta basin in N.T.D. of the Volta Region.

The specific objectives of the study are to:

- compare the occupations and livelihood systems of the people in the communities before and after the construction of the dams,
- examine the effects of the hydroelectric power schemes on the socio-economic lives of the people in the study area,
- assess the effects of the dams on the river and its immediate environment in the lower basin within the study area,
- evaluate the effects of the present socio-economic activities of the people in the study communities on the environment.
- assess people's coping mechanisms in the study communities.

Research questions

The following questions shall be addressed by the study.

- What were the main occupations of the people in the communities before the Akosombo and Kpong dams were constructed and what jobs do people currently do in the communities?
- How did the development of the hydroelectric power schemes affect the socio-economic lives of people in the study area?
- What effects do the hydropower schemes have on the Volta River and its immediate environment in its lower basin in the six Mafi communities?
- How do the present socio-economic activities of people in the study area affect the natural environment?
- What measures have been put in place in the communities for the people to cope with the effects of the hydropower schemes?

Rationale for the study

The findings of the study will provide valuable information to Government, Policy Makers, Hydroelectric power scheme Authorities, District Assemblies, Civil Organisations, and the general public with regard to the facts and guiding principles for the development of new hydropower schemes. The study will also contribute to existing literature on the topic and as well establish new benchmarks for further studies into new concerns in the area.

Organisation of the study

The study is put into five chapters. Chapter one contains the background to the study, problem statement, objectives of the study, research questions, rationale for the study and organisation of the study. The second chapter deals with literature review. It considers existing literature on the historical development of hydropower schemes, choice of sites for hydropower schemes, effects of hydropower schemes on the lives of people and environment in lower river basins, theoretical framework and conceptual framework for the study.

Chapter three consists of the methodology of the study: profile of the study area, study design, study population, sampling, data collection, ethics, field work, field challenges and techniques employed for data analysis. While chapter four contains results and discussions of field data, the last chapter highlights the summary of findings, conclusions and recommendations of the study.

CHAPTER TWO

REVIEW OF LITERATURE

Introduction

Much information has been written on the effects of hydropower schemes on the socio-economic lives of the people and the environment in lower river basins in many countries in the world. It is therefore, essential to examine existing literature which is relevant to in-depth understanding of the study on the topic "effects of the Akosombo and Kpong power schemes on six selected Mafi communities in the Volta Region".

Historical development of hydropower schemes

A hydroelectric scheme involves construction of a dam that impounds rivers or underground streams to generally serve the primary purpose of retaining water, while other structures such as floodgates or levees are used to manage or prevent water flow into specific regions. In the Domesday Book 1086 there are reports of 5,600 water mills in England. Most of the first dams were built in Mesopotamia up to 7,000 years ago.

The earliest dams of which records exist were built to divert the Nile in Egypt in order to provide a site for the city of Memphis and on the Sadd Al-

Kafara at Wadi Al-Garawi (which is located about 25 kilometers south of Cairo,) about 4000 BC and built around 2600 B.C respectively. Many ancient earth dams, including a number built by the Babylonians, were part of elaborate irrigation systems that transformed unproductive regions into fertile plains capable of supporting large populations. Because of the ravages of periodic floods, very few dams more than a century old are still standing. The oldest surviving and standing dam in the world is believed to be the Grand Anicut, also known as the Kallanai, an ancient dam built on the Kaveri River in the state of Tamil Nadu located in southern India. It was built by the Chola king Karikalan, and dates back to the 2nd century AD (Encarta Encyclopedia Standard, 2005).

The construction of virtually indestructible dams of appreciable height and storage capacity became possible after the development of portland cement, concrete and the introduction of earth-moving machines and materials-handling equipment (http://en.wikipedia.org/wiki/Dam). Before the knowledge and large-scale burning of fossil fuels, energy provision came essentially from many renewable resources including thousands of small-scale hydropower-schemes (Encarta Encyclopedia Standard, 2005)

More recently, there have been many dam-based hydropower schemes built around the world. Examples are, Pontalto Dam, built in Austria in 1611, Glen Canyon Dam in United States on the Colorado River (about 216 m (710 ft) high and 475 m (1,560 ft) long), Hoover Dam, also on the Colorado River (completed in 1936, it is 221 m (726 ft) high and 379 m (1,244 ft) long) and Cabora Bassa Dam on the Zambezi River, in Tete Province in Mozambique (303

m (995 ft) wide at the crest and 171 m (560 ft) high). The dam impounds a lake 240 km (150 mi) in length. It has an installed capacity of 2,075 megawatts and a planned capacity of 4,000 megawatts. The Portuguese colonial government began construction in 1969 and exportation of hydroelectricity to South Africa began in 1977. Portugal hoped the scheme would provide hydroelectricity both for local industrial development and for export to South Africa, and water for a proposed irrigation project covering 1.5 million ha (5,800 sq mi) (Encarta Encyclopedia, 2005).

Other examples of hydroelectric power schemes include the following. Tarbela Dam, completed in 1977 on the Indus River in Pakistan is about 148 m (485 ft) high and 2,743 m (9,000 ft) long (http://Wikipedia.org/Wiki/Tarbela Dam). The Itaipu dam (completed in 1982) on the Paraná River, between Brazil and Paraguay, has hydroelectricity capacity of 12,600 megawatts. The lake behind the dam is 180km long and 5km wide. The scheme generates 14 GW and supplied 93% of the energy consumed by Paraguay and 20% of that consumed by Brazil as of 2005 (http://en.Wikipedia.org/Wiki/Itaipu_Dam).

Hydroelectric power schemes among others in Africa include the following. The Orange River Hydropower Scheme in South Africa involved construction of the Vaal Dam (70m high, with water storage capacity of 1,750,000 million litres), P. K. LeRoux Dam (with installed electricity generation capacity of 220MW) and Hendrik Verwoerd Dam (completed in1971 is 90km long and 15km wide). Tana River Hydro-Project in Kenya involved construction of three dams at Kindaruma, Kamburu and Gitaru with combined electricity

production capacity of 200MW between 1968 and 1978 (Pritchard, 1988). The Inga Dam with electricity generating capacity of about 30,000MW in Zaire began in 1968 and was to be completed in 11 stages. The first phase completed in 1972 produces 1,100MW of electricity (Pritchard, 1988).

Hydroelectric schemes established on the Bia and Bandama rivers in Cote d' Ivoire produce about 38 per cent of the country's electricity requirements. (Encarta Encyclopedia, 2005). Other hydropower schemes are the Grand Chutes power station on Samou river in Guinea and Mount Coffee power station on the St Paul River in Liberia with electricity production capacities of 18, 000KW and 7, 500KW respectively (Owereko, 2003).

Choice of sites for hydropower schemes

Many of the most suitable sites for hydropower-schemes have already been exploited, usually by building enormous dams, several of which constitute the largest structures in the world. A number of factors or conditions are considered through feasibility (geological, engineering and socio-economic) studies to enhance the selection of appropriate sites for hydroelectric-power schemes (http://en.wikipedia.org/wiki/Dam).

When a site is being considered for construction of a dam, earthquake hazards are taken into account as part of a thorough geologic analysis. In addition, geologists determine whether the natural foundations are subject to seepage and whether they have the strength to support the weight of the dam and the water that will back up behind it (http://en.wikipedia.org/wiki/Dam).

The height of a dam is limited by the topography of the site. Gorges on the banks of rivers in the basins are considered as appropriate sites as they usually provide the needed embankments for the inundated water that accumulates behind the concrete wall built. However, other factors may dictate a less than maximum height. If the primary purpose of a dam is power generation, the dam height is critical, for the power generated increases in direct ratio to the head (height) of water impounded. For flood-control dams, storage volume is the primary consideration. Above a certain height, increase in storage volume for various functions may not justify the greater resulting cost of construction. Other limiting factors include the value and usefulness of land that will be submerged and interference with highways and railways (http://en.wikipedia.org/wiki/Dam).

The lake or reservoir formed by a dam may be very large. For example the Kuybysheve reservoir behind the Zhiguli dam on the Volga River in Russia is 2800m long, 750m wide and 52m high. The Zhiguli concrete dam completed in 1957 has two-lane navigational locks and a power plant house with installed power generating capacity of 2345MW and an annual average production of 10500GWh electricity (http://en.Wikipedia.org/Wiki/Dam). Completed in 1986, Guri Dam on Caroni River in Venezuela, with a height of 162m and a length of 1300m, is one of the highest dams in the world. The dam has an installed capacity of 10235MW and generates 87000GWh of electricity annually and the Atakurt hydroelectric power scheme constructed on the Euphrates River in Turkey produced a dam 1820m long and 169m high. The lake behind the dam covers a land area of 817 sq km (http://en.Wikipedia.org/Wiki/Dam).

The amount and reliability of the water being discharged through the river valley also affect the choice of site for the dam and the size of the dam. The sources of the river and its tributaries are expected to have all year round supply of large volume of water to the upstream section of the river valley. For instance the dam on Yangtze River (in China) receives water throughout the year from principal tributaries such as the Han, Yalong (Ya-lung), Jialing (Chia-ling), Min, and Tuo He (T'o Ho), on the north and on the south, the Wu; at Zhenjiang (Chinkiang), and the Grand Canal(Encarta Encyclopedia Standard, 2005). Aswān High Dam on river Nile receives water throughout the year from Lake Albert (source of the Nile) and tributaries like the Blue Nile, White Nile and Atbara River (Pritchard, 1988).

It is also expected that there must be abundance of rainfall in the upper basin to supply water regularly to the river valley. During periods of heavy rains, lakes Dongting (Tung-t'ing) and Poyang receive some of the overflow of the Yangtze (Encarta Encyclopedia Standard, 2005) and rainfall in the Niger River basin (where Kainji Dam on Niger River is built) ranges between annual averages of 4,064 mm (160 in) per year in the delta, to 254 mm (10 in) at Timbuktu (Pritchard, 1988).

Initially, such large-scale hydropower schemes were seen as quite benign but in the past ten years the true scale of the environmental as well as social impact because of, for example, the displacement of whole villages for hydropower schemes have become issues. Socio-economic implications of the dam for people living in river basins at both the upstream and downstream of the

dam are also considered when selecting a site for dam construction. Many of these schemes have resulted in the displacement of tens of thousands of people to higher ground as large valleys are flooded. This displacement has proved to be a high price to pay. For instance, Three Gorges Dam near the city of Yichang will submerge a stretch of the Yangtze River valley roughly 650 km (400 mi) long, displacing as many as 2 million people and inundating some 8,000 cultural sites (Encarta Encyclopedia Standard, 2005).

Kainji Reservoir on river Niger (Nigeria) covers 1,250 sq km (480 sq mi) submerging many villages and some 44,000 people had to be resettled when the reservoir was created These people represent an ethnically diverse population speaking a dozen languages. New villages were constructed of sandcrete block, a material resembling cinder block, following an architect's design based on traditional concepts. Most of the district town of Yelwa, and all of Wara were rebuilt. Bussa was moved 48 km (30 mi) south to the dam (Pritchard, 1988). The artificial lake created by Aswan High Dam covers an area more than 480 km (300 mi) long and 16 km (10 mi) wide inundating many villages along the Nile (Pritchard, 1988).

There is also growing concern for the safety of many tens of thousands of people who now live under the shadow of these huge dams and who would most likely receive no warning if the dam walls were to fail. Inadequate geologic analyses have resulted in catastrophic losses at the Vaiont Dam in the Italian Alps. On October 9, 1963, 4,000 lives were lost when a rock slide falling into the water behind the dam caused a huge wave to overtop the 262m concrete arch structure,

devastating the valley below for a distance of several kilometers downstream (http://en.wikipedia.org/wiki/Dam). In dams such as those on the Mississippi River, flood discharges are of such magnitude that the spill water occupies the entire width of the river valley, destroying lives and properties in the lower basin (http://en.Wikipedia.org/Wiki/Dam).

Effects of hydropower schemes on the lives of people and environment in lower river basins

Positive effects

Hydroelectricity projects partly help to address the problem of flooding in lower river basins. It was partly to address the problem of flooding that led the Chinese authorities to begin building the massive, and hugely controversial, Three Gorges Dam, scheduled for completion by 2009, on the Yangtze River. It is claimed by the Chinese government that it will reduce flooding on the Yangtze, which regularly causes considerable loss of life and devastation to property. For example the lower Yangtze region lost more than a quarter of a million lives to floods between 1930 and 1935, 1,200 lives in July 1995 floods and over 3000 people between June and August three years later. From 1960 to 1961 the waters of Lake Kariba were built up behind the Kariba dam on River Zambezi to control flooding and to supply hydroelectric power for Zambia and Zimbabwe. A system of storage reservoirs near the headwaters of the Mississippi and a series of flood-control dams along the river and its tributaries help maintain a relatively even flow of water (http://en.wikipedia.org/wiki/Dam).

Hydropower schemes also help partially to provide sites for settlement development in the lower river basins. For example, the first dam of which record exists was built about 4000 BC to divert the Nile in Egypt in order to provide a site for the city of Memphis (http://en.wikipedia.org/wiki/Dam).

The schemes promote development of new settlements with well equipped socio-economic facilities in lower river basins for affected people. For instance, 75 new government townships including Kom Ombo were built 65km north of the Aswan High Dam when the hydropower scheme came into being (Pritchard, 1988).

Hydropower projects help to reclaim agricultural lands from flood waters below dams in the lower river basins. Although of great fertility, lands in lower Mississippi basin had not been fully cultivated because of the dangers of flooding until series of flood control dams were built to overcome the silting caused by vast deposits and the constant changes caused by floods (http://en.wikipedia.org/wiki/Dam). The Three Gorges scheme was also designed to protect some 10 million people downstream from widespread flooding in a plain that supplies two-thirds of China's rice (Encarta encyclopedia, 2005).

Hydropower scheme dams help to reduce losses of plant and animal species to flood waters in lower river basins. ‘Disaster hit Mozambique in February and March 1945 when catastrophic flooding occurred, following torrential rains and cyclones, first in the south and then in the north of the country. The floods, the worst in Mozambique's history, caused most damage in the Limpopo River valley, north-east of Maputo. Rivers Limpopo, Save, and

Zambezi, and then Messalo in the north, overflowed and expanded, killing tens of thousands of livestock and ruining vital crops as well as natural vegetation and wildlife. However, the Kariba Dam constructed between 1955 and 1959 for Hydroelectricity-project had since reduced the level of damage caused to natural vegetation and wildlife in Mozambique and Zimbabwe by floods' (Encarta Encyclopedia Standard, 2005).

Negative effects

Dam failures are generally catastrophic if the structure is breached or significantly damaged. These threaten the lives of thousands of people who live below the dams. Inadequate design of spillway for example, led to the 1889 over-topping of the South Fork Dam in Johnstown, Pennsylvania, resulting in the infamous Johnstown Flood. The Johnstown Flood disaster (or Great Flood of 1889 as it became known locally in USA) occurred on May 31, 1889. It was the result of the failure of the South Fork Dam situated 14 miles (23 km) upstream of the town of Johnstown, Pennsylvania, USA. The dam's failure unleashed a torrent of 20 million tons of water (18.1 million cubic meters/ 4.8 billion U.S. gallons) in the lower basin of Little Conemaugh River. The flood killed over 2,200 people and caused US$17 million worth of damage (http//en.Wikipedia.org/wiki/Johnstown_Flood).

It has been noted that decaying vegetation in flood waters can release two greenhouse gases like methane and carbon dioxide (Waugh, 2003). According to the World Commission on Dams report, when no prior clearing of vegetation in

the flooded area was undertaken, greenhouse gas emissions from the flood waters could be higher than those of a conventional oil-fired thermal generation plant (Waugh, 2003).

According to Waugh (2003) silt, previously spread over farmland in lower river basins, will be deposited in the lake when dams are constructed for hydropower projects. The dam wall built across the river serves as an obstacle or barrier and therefore, prevents the silt from moving downstream.

In the view of Nader (1970), dam construction on rivers usually leads to marked reduction in volume of water in lower river valleys (Geography Encyclopædia Britannica). Pekka Haavisto, Finland's minister for Environment and Planning (1995) also stressed that water in the lower valleys becomes shallow when dams are constructed on rivers upstream. According to Nader (1970) and Haavisto (1995), the huge walls built across the rivers together with the raised banks (gorges on both banks) create large hollows to house the incoming upstream flowing water and prevent the water from flowing naturally downstream. The openings (or outlets) created are so small that only a smaller amount or volume of the housed water is allowed to flow into the valley below the dams (Encarta Encyclopedia Standard, 2005).

According to environmentalists (such as the United Tasmania Group (U.T.G) of Australia led by Richard Jones, and Ralph Nader), the reduction in volume of water in lower river valleys as a result of dam construction allows growth of water weeds that cover the surfaces of rivers. This causes significant

ecological changes in affected areas. An example is the hyacinth vegetation on the Nile in Egypt.

Areola, Mamman, Onweluzo and Omotoso (2001) also stated that dams constructed upstream disrupt the flow regime of rivers below the dams. Rivers depend on the constant disturbance of a certain tolerance. Dams slow the flow of rivers and this disturbance may damage or destroy the pattern of flow regimes in lower river basins (http://www.bookrags.com/wiki/Dam).

Another effect is the destruction of fishing industry in lower river basins. Usually, the amount of fish catch in the lower basin is reduced when a dam is constructed upstream leading to reduction in volume of the river in the lower basin (Waugh, 2003).

It is also established that dam construction may require moving people from their original places of abode and resettling them in new areas. This programme usually results into dislocation of established families, family values and the loss of many valuable archaeological and cultural sites (Areola, et al. 2001).

In the views of critics (like Pekka Haavisto, Finland's minister for environment and planning (1995) and Richard Jones), of hydro-schemes, construction of dams hinders the development of water transportation downstream below dams. The water in the lower valley becomes so shallow that modals such as ferries, large boats and canoes find it difficult to sail on the river (Encarta Encyclopedia Standard, 2005).

The dwindling volume of water in the lower river valley also facilitates the

spread of water related diseases like bilharzias, malaria and river blindness in the lower basin. It is noted that water weeds breed harmful flies and germs such as black flies, mosquitoes etc that cause river blindness, malaria and bilharzias (Iwena, 1996).

Poverty, economic condition in which people lack sufficient income to obtain certain minimal levels of health services, food, housing, clothing, and education, generally recognised as necessary to ensure an adequate standard of living is also a product of hydropower schemes in lower river basins below dams. A report by the United Nations Environment Programme (UNEP), known as GEO-2000, identified excessive consumption of energy including hydropower, raw materials, and other resources in Western and some East Asian nations as one of the main causes of the continued poverty of the majority of world population. Extreme poverty in many parts of the world forces residents of those areas to exploit natural resources in an unsustainable manner. Both factors have considerable economic and environmental implications (Encarta Encyclopedia Standard, 2005).

It has been established that people who lost their sources of livelihood like fishing and water transport operations in lower basins due to dwindling volume of water in valleys usually turn to farming and wood harvesting for firewood and charcoal burning as their occupations. These activities most often lead to deforestation and serious erosion in the lower basins along the river and consequently result in climatic change that invariably affects the lake behind the dam (http://en.wikipedia.org/wiki/Dam).

Hydroelectric generation can be vulnerable to major changes in the climate, including variation in rainfall, ground and surface water levels, and glacial melt, causing additional expenditure for the extra capacity to ensure that sufficient power is available in low water years (http://www.bookrags.com/wiki/Dam).

Theoretical framework

The effects of hydropower schemes on communities in lower river basins should be studied in the light of theories that establish relationships between the environment and people's lives in given localities. The studies should be consistent with theories or principles that can be evaluated in terms of established relationships between environmental conditions on one hand and social, economic and cultural lives of human-beings in their settings on the other. Environmental determinism and environmental possibilism theories used to establish these relationships have been sighted in existing literatures and reviewed for the study of the "effects of the Akosombo and Kpong power schemes on six selected Mafi communities in the Volta Region".

Charles Darwin's idea to establish relationships between people and the environments in which they lived was later developed by a German geographer Friedrich Ratzel to be known as environmental determinism. In his first volume of his chief work, Anthropogeographie (1882) he argued that cultural as well as natural phenomena could be subject to systematic study. He also stressed the extent to which people lived under nature's laws, and argued that cultural forms

were adapted to and determined by the local physical environment. In the second volume, published in 1891 Ratzel modified his views, concentrating more on the historical and cultural background to the distribution of settlement forms and migrations (Encarta Encyclopedia Standard, 2005).

Ultimately derived from Charles Darwin's theory of natural selection, Ellen Churchill Semple (1863-1932) argued that environmental determinism was based on the view that the natural environment is the main determinant of the way in which human societies develop. In other words, the social and cultural life, temperament, religion, and economic practices of people in a particular area are all the result of the influence of their physical surroundings. Her first book, American History and its Geographic Conditions (1903), was principally concerned with the geographical factors behind major national historical events such as the advance of the western frontier and the American Civil War of 1861-1865. It established Semple's reputation and, despite an overemphasis on the impact of the physical environment, it is still regarded as a classic work of American geographical literature (Encarta Encyclopedia Standard, 2005).

In 1908 in Ohio Semple delivered an address with the statement: "Man is a product of the Earth's surface." This viewpoint, which typified her approach to geography, was expanded most fully in Influences of Geographic Environment (1911). In a book, which drew heavily on Ratzel's views and accordingly subtitled "On the Basis of Ratzel's System of Anthropogeography", Semple reaffirmed her view of the importance of the natural environment, which was essentially unchangeable in contrast to "shifting, plastic, progressive,

retrogressive man". Although she rejected the term "determinism", preferring instead "geographical control", she also regarded location as the "supreme geographic fact in the history of a country or people". (htt://www.colorado.edu/geography/giw/semple-ec/semple-ec.html).

Huntington, Ellsworth (1876-1947), American geographer, explorer, and author, whose work focused on the effects of climate on human heredity and civilization, published The Pulse of Asia, in which he advanced the idea that Mongol and Manchu migrations were caused by climatic change. Until his retirement in 1945, Huntington's work concentrated on cultural geography and climatic studies. Huntington's work was wide ranging, but is noted particularly for its concern with the effects of climate on human heredity and civilisation. (htt://www.colorado.edu/geography/giw/huntington-e/Huntington-e.html).

However, by the early 1930s determinism was becoming less acceptable, not only because of its lack of explanatory rigour but also, in the light of events in Europe, because of the nature of some of its conclusions. Semple herself, in Influences of Geographic Environment, had characterized northern Europeans as "energetic, prudent, and serious", in contrast to people of the Mediterranean basin who were "easygoing, improvident, except under pressing necessity", and Africans, among whom, she said, the Mediterranean characteristics had "degenerated into grave racial faults". Racist implications resulting from some of her followers' work were even more radical. Huntington's approach to geographical study, sometimes called environmental determinism, also resulted in claims for the superiority of the peoples of the temperate zone to those of the

tropics and intermediate zones. Such conclusions are today viewed as ethnocentric and of little scientific environmental determinism. The concept became fully discredited particularly, when Nazi propaganda used its premises to justify ideas of racial superiority, as expressed in Adolf Hitler's Mein Kampf and, in practice, in the formation of concentration camps (Encarta Encyclopedia Standard, 2005).

Geographers such as Paul Vidal de la Blache (1900-1920), the most influential figure in regional and human geography in France and Herbert J. Fleure (1940) in Britain on the other hand developed Darwin's concept into the theory of environmental possibilism, in which the environment influences human activity without determining it, while in return human-beings affect the physical environment. They emphasised that the natural and human environments were intimately linked, acting upon each other to produce unique genres de vie, or lifestyles, located in distinct regions, or pays. Paul Vidal de la Blache and Jean Brunhes further viewed the relationship between human-beings and the environment as one of interdependence and repercussion (people were both influenced by and influenced the environment around them) (Encarta Encyclopedia Standard, 2005).

By the 1940s, geographers in Germany, France, and Britain adopted the environmental possibilism concept, as a framework for developing the idea of a region, seeing in it an analytical approach to providing a synthesis between the physical and human aspects of the environment. For instance, Ferdinand von Richthofen, and Alfred Hettner argued that the purpose of regional geography was

to provide an understanding of causal relationships of phenomena in particular areas, and that this understanding was to be expressed in general principles applicable to the interpretation of individual regions. In other words the study of unique phenomena was needed to construct generalisations, or laws, and laws were needed to understand the particular combination of unique phenomena that make up regions. Hettner was particularly concerned about the growing split between human and physical geography (Encarta Encyclopedia Standard, 2005).

Even though, both theories emphasised causal relationships between people's lifestyles and the environments in which they live, the possibilism theory went further to indicate how human beings affect the physical environment in return. On that basis, Paul Vidal de la Blache and Herbert J. Fleure's theory of environmental possibilism, has been adopted as the most appropriate theoretical framework within which to research into the subject under study.

Conceptual framework

Geography, from the Greek geographia, means "earth description" or "science that broadly deals with the structures and processes of the Earth's physical and human environments and the interactions between the two, particularly in their spatial contexts. Put even more broadly, geographers seek to understand the way our world works and why it appears as it does". This involves explaining the processes operating below, on, and above the Earth's surface and the ways in which these processes have created the landscapes around us and continue to change them as well as the ways in which human- beings have been

affected by and in turn have modified the natural environment, and how and why human structures and activities have developed in different ways in particular places (Encarta Encyclopedia Standard, 2005).

According to the Greek geographia, the concept of region integrates the human and physical environments, enabling an understanding of the interactions between them in different localities. The regional concept is in use as an analytical tool. For example, it has been used to study the ways in which the concentration of particular skills influence where firms choose to locate, or the influence of the media on the creation of regional identities. The integrative approach that characterised regional geography in the past also survives in modern landscape geography which is concerned with the analysis of the nature of place as an interaction between communities and environments. To this end, landscape geographers look not only at the physical realities of the human and natural environments, but also at the way these environments are and have been perceived, and the way this has acted as an active agent in landscape development in specific localities (Encarta Encyclopedia Standard, 2005).

To the Greek geographers, regional geography involves the study of people and their activities and structures, whether economic, social, cultural, or political and also encompasses the ways in which people interact with the natural environment. At its simplest it involves the description, analysis, and mapping of where, for example, industries or towns are located. In particular, it seeks to understand how and why human structures and activities have developed in particular ways in particular places.

The conceptual framework for this study is developed from the views of Greek Geographers on regional geography where they established relationships between 'natural environmental conditions', 'human actions' and 'development of new landscape' in a given area. The framework entitled, "Triangular framework of interrelationships in locality (region)" is a plan of three sets of facts or ideas that are connected to one another by means of directional interrelationships in the plan. The sets are natural environmental conditions, human beings and new landscape developed from the interactions between human actions and environmental resources as shown in Figure 1. The Figure explains how the use of the river (natural condition or resource) for dam construction affects people's lives and the development of new landscape. The Figure further indicates how new landscape developed, influences peoples' activities and the river together with the dam. The framework finally shows that human activities also affect the development of new landscape and the river together with the dam in the river basin.

The interactions between the two dams together with the Volta River, people's socio-economic activities and natural environment in the study area represent the sets of facts in the triangular framework of interrelationships in a locality (region). The interrelationships established between man, the natural environment and new landscape in the study communities emphasise cause and effects relationships conceptualised in the Figure. This therefore, makes the Figure suitable for this study since it seeks to find out the interrelationships between the two hydropower schemes at Akosombo and Kpong, the socio-

economic lives of people and the environment in the study communities in the lower Volta basin in the North Tongu District of the Volta Region.

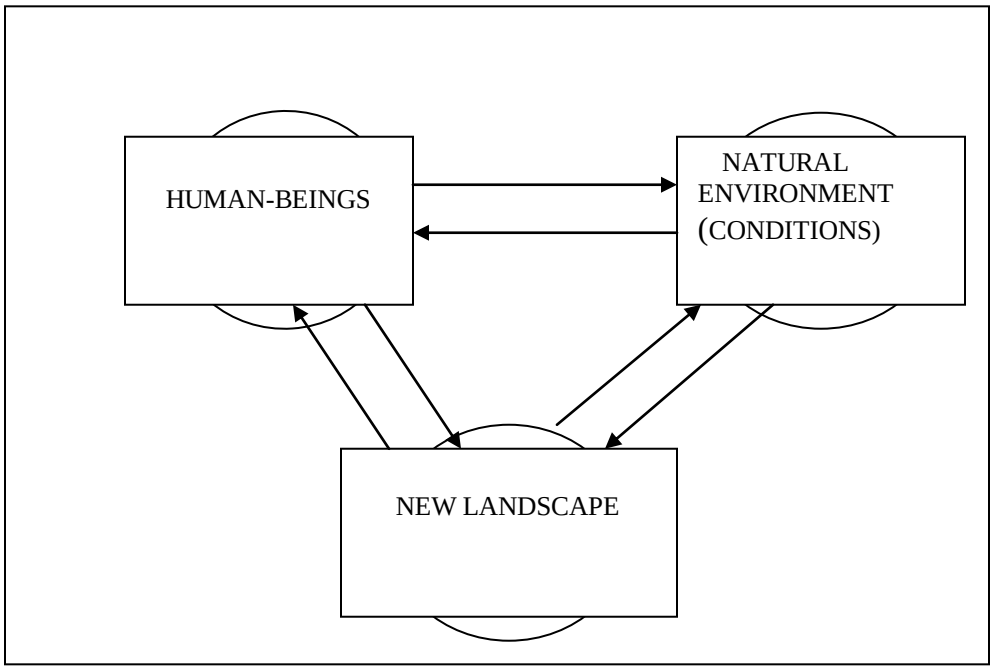

Figure 1: Triangular framework of interrelationships in locality

Source: Author's construct, 2009

CHAPTER THREE

METHODOLOGY

Introduction

This chapter highlights the profile of the six Mafi communities that form the study area, study design, the study population, sampling procedures and the methods of data collection. Field work, field challenges and the method(s) of data analysis have also been discussed in this section.

The study area

Mafi communities in this study refer to six selected settlements that are sited close to the Volta River in Mafi traditional area (see map in Appendix II showing locations of the study communities). The settlements spread on the west bank of the river in the North Tongu District of the Volta Region. The communities are Agbenyorkorpe, Aklamador, Aloryi, Devime, Dokpo and Dugame).

The communities vary in size and are independent of each other. Three of the communities are ruled by chiefs, one by a regent and each of the other two by a headman (someone appointed by a community or village to lead them but does not have a title and stool).

Like the rest of the district, the communities in the study area are not easily accessible to one another. The roads connecting the communities, and to other settlements like Dove, Kelekor, Kebegodo and Kumikpo are rural (feeder) roads and quite often impassable in the rainy season. The district capital, Adidome on the east bank of the river is directly accessible by only canoes to the communities in the study area.

Study design

A synthesis of qualitative and quantitative methods was employed to investigate the study problem. The study design was selected in view of the fact that the study involves systematic collection and presentation of data to establish the links between hydropower schemes, socio-economic lives of people and the natural environment in lower river basins of the Volta River.

Extensive interview which focused on households was conducted in the study communities. The interview technique was adopted in order to gain a thorough understanding of the problem under study. Questionnaires were used to gathered data from the planning unit of North Tongu District Assembly, Community Development and Environmental units of Volta River Authority (V.R.A) and Environmental Protection Agency (EPA). The nature of questions and mode of administration made it possible for me to get 100% responses which would not have been possible with in-depth interview, given the work and time schedules of the responding officers. Observations were made to identify and to assess the effects of the hydropower schemes in the study area. Research reports,

news papers, periodicals, journals, project reports and web sites were valuable sources of secondary data.

Study population

The six communities together have a total population of about 2426 with Agbenyorkorpe having 306 people, Aklamador 219, Aloryi 197, Devime 804, Dokpo 397 and Dugame 503 (North Tongu District Water and Sanitation Plan, 2007). Adult population in the communities was estimated as 1179, representing 48.6% while people below 20 years of age were 1247, forming 51.4% of the total population (North Tongu District Water and Sanitation Plan, 2007). The number of households and household heads by sex resident in each of the communities are indicated in Table 1.

Table 1: Distribution of households and household heads

Community	Number of households	Female heads	Male heads
Agbenyorkorpe	31	18	13
Aklamador	53	28	25
Aloryi	39	19	20
Devime	104	53	51
Dokpo	32	11	21
Dugame	109	63	46
Total	368	192 (52.17%)	176(47.83%)

Source: Fieldwork, 2008.

The average household sizes in the communities are; Agbenyorkorpe 9.87, Aklamador 4.13, Aloryi 5.05, Devime 7.73, Dokpo 12.40 and Dugame 4.61.

The main economic activity of the people in the communities is farming associated with subsistence fishing, petty trading and charcoal burning. The crops grown in the area are cassava, maize, beans and vegetables. Fish catch in the communities include oyster, tilapia, shrimps and mud-fish. Oyster shell mining is also done occasionally or on requests for construction purposes. While women dominate petty trading and charcoal burning, the men are associated with subsistence fishing in the study area. A few numbers of men in Devime and Dugame in particular engage in boat transport operations on the river.

Sampling

Household heads resident in the communities, North Tongu District District Planning Officer, Personnel of Community Development and Environmental units of Volta River Authority (VRA) as well as Environmental Protection Agency constituted the study population.

Using Crejcie and Morgan's table for determining sample size (Sarantakos, 1988) a total sample of 289 respondents (Household heads) was selected to represent adult population of 1179 in the six communities. However, for the purposes of time and resources constraints, 122 resident respondents were sampled for the study.

Systematic sampling procedure was employed to select the sample units from among household heads for the study. The total of 368 households in the six

communities and the estimated sample of 122 were used to determine a common sample fraction (k=N/n, where N=target population: 368; and n=sample size: 122. Therefore 368/122 =3.0163 which is app. =3).

The first names of resident household heads were compiled in alphabetical order and given serial numbers to form a sample frame for each of the six communities as Agbenyorkorpe 101,102, 103… 131; Aklamador 201, 202, 203… 253; Aloryi 301, 302, 303… 339; Devime 401, 402, 403… 504; Dokpo 601, 602, 603… 632 and Dugame 701, 702, 703… 809.

Three (3) was randomly selected from a set of 1, 2 and 3 (sample fraction range) and used to determine the first sample unit (as Agbenyorkorpe 103; Aklamador 203; Aloryi 303 etc) from each of the six sample frames. The subsequent sample units were identified by adding the sample fraction (3) until the sample frames got exhausted. Agbenyorkorpe had 103, 106, 109, …130; Aklamador 203, 206, 209, …251; Aloryi 303, 306, 309, …339; Devime 403, 406, 409,…502; Dokpo 603, 606, 609,…630; and Dugame 703, 706, 709,…808.

Corresponding names of the numbers drawn were located on the sample frames of the household heads and gathered to constitute the sample populations for the study communities. The number of households resident in each of the six communities and the corresponding samples are indicated in Table 2.

Purposive sampling method was also used to select the North Tongu District Planning Officer, Heads of Community Development and Environmental units of Volta River Authority (V.R.A) as well as Environmental Protection Agency for the study.

Table 2: Distribution of sample population

Community	Number of resident households	Sample population
Agbenyorkorpe	31	10
Aklamador	53	17
Aloryi	39	13
Devime.	104	34
Dokpo	32	10
Dugame	109	36
Total	368	120

Source: Fieldwork, 2008

Data collection

Structured interview approach was adopted to elicit data from the selected respondents by administering detailed interview schedule (shown in Appendix III) in the study communities. The interview guide consisting twenty-six questions was structured into six sections (which covered general issues, effects of hydro schemes on the socio-economic lives of people, effects of hydro schemes on the environment, effects of socio-economic activities of people on the environment, benefits of the schemes to the communities and copping mechanisms in the study area. The local language (Ewe) was used to conduct the interview so that the interviewees could express themselves effectively.

Observation method was also adopted to identify and assess the environmental implications of the dam and current socio-economic activities of

the people in the study area. Photographs were taken of some evidence of the hydroelectric power schemes' effects in the study area (shown in Appendix 1).

A ten item questionnaire (Appendix IV) was administered to the North Tongu District Planning Officer, Heads of Community Development and Environmental units of Volta River Authority (V.R.A) and Environmental Protection Agency. The data gathered from these institutions were used to complement as well as verify information given by target group in the study communities. Secondary data was obtained from research-reports, news papers, periodicals, journals, and project reports.

Ethical consideration

Since the problem being investigated bothered on the livelihood systems and socio-cultural values of households and the images of VRA and government as well as its ministries, departments and agencies (MDAs), the respondents were assured of the needed confidentiality. This was stated clearly on the interview guide and on the questionnaire (Appendices III and IV).

Field work

The study was conducted within twenty-two months, starting from November, 2007 to September, 2009. Financial and time limitations compelled the researcher to take a sample of one hundred and twenty (122) respondents instead of two hundred and eighty-nine (289).

Acquisition of primary data involved interaction, with resident respondents during field visits to the study area, through individual interviews between October and December, 2008. I used structured interview guide to collect information from household heads selected for questioning. I sought assistance of a young man (Field assistance) who knows the study area very well. I found the field assistant helpful in penetrating the study area since the communities are widely spread apart in the study area and are not easily accessible to one another.

With the help of introduction letter from the Institute for Development Studies, I administered a ten item structured questionnaire to the environmental and community development units of VRA and EPA through their corporate services departments. The same questionnaire was administered to the Planning Officers of the N.T.D.A.

Field challenges

Irregular vehicular movements between some of the communities hindered the movements of the research team from one community to the other. Access to other communities was by foot and the rest by canoes since most of the communities are not directly connected by roads.

Officials of Volta River Authority (VRA) were reluctant to give out information on the theme under study. Another difficulty encountered was the delay by some staff of Environmental Protection Agency (EPA) to release completed questionnaires.

The research team however, received co-operation from North Tongu District Assembly and interviewees, opinion leaders, assemblymembers, headmen and chiefs within the communities.

Data analysis

Field data obtained were edited, coded manually and computerized. Descriptive statistics were used in the data analysis. Data were summarised using, frequencies, percentages and cross-tabulations. To guard against drawing unjustified conclusions the data were examined for differences, patterns and relationships established in the responses provided by respondents.

The parameters considered in the data analysis include population structure and out-migration, level of education, health, occupation, income and poverty status, transportation and the natural environment.

CHAPTER FOUR

RESULTS AND DISCUSSION

Introduction

This chapter deals with the presentation and analysis of demographic characteristics of respondents, and the determination of the effects of hydropower schemes on the socio-economic lives of people and the natural environment in six Mafi communities (Agbenyorkorpe, Aklamador, Aloryi, Devime, Dokpo, and Dugame) in the Volta Region. One hundred and twenty resident respondents selected through systematic sampling procedure were interviewed in the study area.

Background characteristics of respondents

The sex distribution of resident respondents is presented in Table 3.

Table 3: Sex distribution of respondents

Sex	Frequency	Percents
Male	59	49.2
Female	61	50.8
Total	120	100.0

Source: Fieldwork, 2008

Table 3 shows that, a total of 120 household heads were interviewed. Out of the 120 respondents, 59 (49.2%) were males, while 61 (50.8%) of them were females. The 49.2% to 50.8% ratio of male to female respondents is a reflection of the dominance of female household heads in most of the study communities. This implies high prevalence of broken homes and higher rate of out-migration among married men than their female counterparts in the study communities.

Table 4 shows age distribution of resident respondents.

Table 4: Age distribution of respondents

Age cohorts	Female	Male	Total	Percentage
20-20	2	0	2	1.66.7
30-39	7	7	14	11.667
40-49	12	9	21	17.5
50-59	16	8	24	20.0
60-69	12	2	14	11.667
70-79	5	22	27	22.5
80-89	6	5	11	9.167
90-99	0	2	2	1.667
100-109	1	4	5	4.167
Total	61	59	120	100.0

Source: Fieldwork, 2008

The age distribution indicates that, 30.833% of the respondents fell between the age range of 20 and 49 years while 69.167% were above 50 years.

This distribution therefore shows that, 69.167% of the respondents were older than the two hydroelectricity power schemes (Akosombo Dam completed in 1963 and Kpong Dam completed in 1981) and were witnesses to the socio-economic and environmental conditions in the study communities before and after construction of the dams on the river. The remaining 30.833% were also matured enough to assess the effects of the hydropower schemes on the socio-economic and environmental conditions in the study communities. The age-sex structures of the respondents show that there are more female household heads than their male counterparts between the ages of 20 and 69 while there are more male household heads between ages of 70 and 109 years.

Probing the respondents, I found that there are higher rates of divorce among couples between the ages of 20 and 69 and high rates of out-migration among male household heads between 20 years and 69 years of age in the study communities. I also found that surviving male household heads return to the communities after the age of 69 years.

Educational background influences the nature of people's traditional socio-economic activities, perception, attitude to changes and the adoption of new knowledge and technologies as well as the possibility of changing occupations and livelihood systems. Therefore, the educational backgrounds of the resident respondents in the study communities were assessed. The educational background of the resident respondents according to sex is shown in Table 5.

It can be identified from Table 5 that, 68 respondents out of a total of 120

had no education at all. The 68 respondents consist of 30 males and 38 females. The Table also indicates that, 42 respondents had basic education. Out of the 42 respondents, 23 were males while 19 of them were females. It can also be noted in the Table that, 4 males and 4 females had secondary education whereas only 2 males reached the tertiary level.

Table 5: Educational status of respondents

Sex	No. education	Basic education	Secondary education	Tertiary	Total
Male	30	23	4	2	59
Female	38	19	4		61
Total	68	42	8	2	120

Source: Fieldwork, 2008

Responding to follow-up questions, the respondents revealed that majority of the people in the study communities find it difficult to adopt new technologies and systems of livelihood after the two hydropower schemes on the Volta River came into being. According to the respondents, the difficulties were due to no or low level of education among the people in the study communities.

Occupation and livelihood systems of people before and after construction of dams on the Volta River

The study compared the occupations and livelihood systems of the people in the six selected Mafi communities before and after construction of dams on the

Volta River. The following questions were used to elicit responses from resident respondents. What were the main jobs of the people in the communities before Akosombo and Kpong dams were constructed? What jobs do people currently do in the communities?

Table 6 shows the types of occupation and livelihood systems of people in the six study communities before the dams were built. The Table shows multiple responses of the resident respondents.

Table 6: Occupations of people before dams were constructed

Occupation	Frequency	Percent
Farming	120	24.8
Fishing	120	24.8
Trading	104	21.5
Oyster shall mining	21	4.3
Firewood and charcoal	21	4.3
Boat operation	97	20.1
Total	483	100.0

Source: Fieldwork, 2008

From Table 6, it can be found that all the 120 respondents interviewed indicated that farming and fishing were the main jobs of people in the communities while 104 and 97 out of the 120 interviewees stated that trading and boat operation respectively, were jobs people engaged in for their livelihood before the dams were constructed. However, only 21 respondents out of the 120

interviewees indicated that firewood and charcoal burning and oyster shell mining were jobs of people in the communities. These signify that charcoal burning and oyster shell mining were not popular occupations in the study communities before the two hydropower schemes were developed on the Volta River.

Further responses provided by the respondents indicated that, before the two dams were constructed, fishing and farming were the main occupations of the people in the communities, followed closely by trading and water transport related businesses. Among the common fish species caught in the area in great quantities, according to the respondents were clams (oyster), tilapia, schilbeidae etc. A respondent noted that the quantity of fish catch made the local economy so vibrant that people from far and near descended on the communities daily to either buy fish for resale elsewhere or to sell manufactured goods to the local people. According to the respondents, resident women were also involved in fish trade between the communities and other known commercial towns like Adidome, Ho, Akatsi, Dabala, Ada and Accra while some men even opened shops in the communities to sell merchandise goods.

The respondents further stated that ferries, launch, canoes and machine powered boats were modals used to cart people and goods across and along the river. According to them, operators reached as far as Ada, and Akuse with their modals on daily basis. The respondents also indicated that wood harvesting though existed in the area it was done on a small scale for domestic uses and for smoking fish. Even that, the target then was dried tree branches in woodlots and

forests. According to the respondents, farming was done to cultivate only subsistence crops such as maize, cassava and vegetables to feed the households.

The occupational structure and livelihood systems adopted in the study area before the dams were constructed on the Volta River were in line with the principles of environmental possibilism theory developed by Blache (1920s) and Fleure (1940). In the environmental possibilism framework they stated that environmental conditions (resources and/or challenges) influence human activity and lifestyles located in distinct regions or pays. Therefore, the presence of free flowing Volta River surrounded by fertile farmlands in the basin, encouraged viable fishing, farming, trading and water transport related businesses in the study communities

The multiple responses of interviewees on the main jobs people currently do in the communities are presented in Table 7.

Table 7: Jobs people currently do in the six Mafi communities

Occupation	Frequency	Percent
Farming	120	30.5
Fishing	44	11.2
Trading	48	12.2
Oyster shell mining	18	4.6
Firewood and charcoal burning	108	27.4
Boat operation	56	14.2
Total	394	100.0

Source: Fieldwork, 2008

Table 7 shows that 120 responses, representing 30.5% of the total frequency of jobs, indicated farming as the main job people currently do in the study communities as their source of livelihood. It is also observed from the Table that, only 11.2% of the total responses stated that fishing is currently going on in the study area. The interviewees however, indicated that the fishing is currently done occasionally on subsistence level to complement fish purchases to meet household needs.

It is further noted in the Table that, trading, oyster shell mining, firewood and charcoal burning, and boat operation (water transport related businesses) formed 12.2%, 4.6%, 27.4% and 14.2% respectively, of the current occupation and livelihood systems in the study communities.

In comparison, it can be noted that the 120 responses to both questions, are indications that farming is currently an important job and a source of livelihood for the people in the six Mafi communities as the situation was before the two dams were constructed on the Volta River. The results also show sharp drops or decreases in popularity of fishing, trading and water transport related businesses in the study communities. It is however, evident in the discussions that oyster shell mining had gained marginal popularity from 4.3% to 4.6% as an economic activity in the study communities. Wood harvesting for firewood and charcoal burning on the other hand, experienced an increase from 4.3% to 27.4% between the period before the two dams were constructed on the Volta River and

the period after the two dams came into being, signifying marked increase in popularity of wood harvesting in the study communities.

The results of the comparative analysis of the occupations and livelihood systems of the people in the six selected Mafi communities before and after the construction of dams on the Volta River established that, there were marked structural changes in the occupations and livelihood systems of the people in the communities, since the hydropower-schemes were developed on the river. Farming that used to be a subsistence activity to produce food crops to feed only household members before the two dams were constructed has become the major occupation, serving as the main income source for the people in the communities while fishing which was the main stay of the local economy has become occasional subsistence activity to complement fish purchases from markets elsewhere. Wood harvesting, targeted at dried tree branches in woodlots and forests for domestic uses and for fish smoking before the hydroelectricity- power schemes came into existence, has now become a major commercial activity in the study communities after the two dams were constructed on the river.

The occupational changes in the study area as a result of construction of two hydropower-scheme dams on the Volta River revealed the positions of the environmental possibilism framework and triangular framework of interrelationships adopted for the study. According to the environmental possibilism framework (Blache, 1920 and Fleure; 1940) the natural and human environments were intimately linked, acting upon each other to produce unique shared features, or lifestyles, located in different regions, or areas. The conceptual

framework also established that there are direct interrelationships between dams, socio-economic activities of people and the natural environments in a locality. Therefore construction of the two dams resulted in changes in the natural ecological system within the entire lower Volta River basin. The changes in natural ecological system directly influenced changes in people's existing occupations in the lower basin including the study communities.

The hydropower schemes and the socio-economic lives of people in the study area

As a way of assessing the effects of the hydroelectricity schemes on the socio-economic lives of people in the six communities after the dams were constructed, a number of questions (Appendices III & IV) were posed to the N.T.D. Planning Officer, Community Development Officers of VRA and EPA as well as respondents selected from the study communities.

All the respondents from the three institutions and the six communities agreed that the two dams have had and continue to have significant effects on people's social and economic lives in the communities. VRA respondents noted that the dams have both positive and negative effects on the lives of the people because, the electricity generated from the dams had been connected to two of the communities namely Aklamador and Devime in 2005, while the others have erected poles awaiting connection to the national grid. However, the traditional sources of livelihood like fishing, has been seriously damaged while water related

sicknesses like malaria, bilharzias and river blindness, have become common in the area.

The resident respondents however, indicated unanimously that the two dams have only negative effects on the lives of people in the communities. According to respondents in Aklamador and Devime where electricity is available, the mere presence of electricity in the communities has no positive effects on their lives since people cannot connect their houses to the grid because of poverty. Respondents in the other four communities could not raise the money for full payment for the counterpart funds required for the rural electrification programme embarked upon in the area by government and therefore, have not been connected to the national electricity grid, despite erection of electricity poles in the communities since 2005.

Evidence provided by the resident respondents to support their assertion that the hydropower-schemes have significant negative effects on the cultural, social and economic lives of people in the communities are shown in Table 8.

From Table 8, 91 (20.9%) out of a total of 435 (100%) responses provided by the 120 respondents indicate that the hydropower schemes on the Volta River have made farmlands more difficult to till in the six communities. In the views of respondents, the regular seasonal floods that used to occur to deposit fertile alluvial soils on farmlands within the floodplains in the area, no longer happen since the dams were constructed. As a result, farmers in the communities have resorted to the use of tractors for ploughing and heavy application of chemical fertilizers. This finding agrees with Waugh's (2003) new wider world that silts,

previously spread over farmland in lower river basins, will be deposited in lake when dams are developed on rivers.

Table 8: Evidence of effects of dams on people's socio-economic lives

Effects of dams	Frequency	Percent
Farmland more difficult to till	91	20.9
Fishing no longer viable	104	23.9
Boat operation damaged	41	9.4
Out-migration	58	13.3
Water related diseases/sickness	24	5.5
Broken homes	12	2.8
Poverty	13	3.0
River not safe for drinking	6	1.4
Houses flooded in 1969 spillage	49	11.3
No trade commodities	8	1.8
Labour shortage	29	6.7
Total	435	100.0

Source: Fieldwork, 2008

The 23.9% of the responses provided in the Table also show that, fishing has not been a viable economic activity in the communities after the construction of the two dams on the Volta River. According to the respondents, the dams built across the river prevent the fishes from migrating downstream, weeds have grown to cover the few fishes in the lower basin and tributary streams that served as

spawning waters for the river in the lower basin, have either dried up completely or are colonised by waterweeds. These conditions have made fish a scarce commodity in their communities which were previously noted for large amounts of fish species such as oysters popularly called 'Aforli' or "Adodi', tilapia, etc. The people now depend on bi-weekly fish supplies from Ada, Keta, Dabala, Dzemeni, Kpando-Torkor, Yeji and Dambai. This revelation confirms that hydropower projects expressed as dam construction for hydroelectricity projects often lead to the destruction of the fishing industry in lower river basins (Waugh, 2003). Usually, the amount of fish catch in the lower basin is reduced when a dam is constructed upstream leading to reduction in volume of the river in the lower basin.

The Table also shows that 9.4% of the responses indicated that the hydropower schemes have caused severe damage to water transport related operations in the study communities. The interviewees stated that after the dams were constructed, the volume of water in the lower river valley had reduced markedly; the flow of the river in their section became so slow and waterweed had colonised the water bodies. These conditions have made it impossible to operate water modals particularly ferry, launch and large boats on the river. They stressed that the only form of vessel operating on the river now is dugout canoes which can berth at only selected points which people have linked to the open water by creating narrow passages between the waterweeds. This confirms the view of Haavisto, Finland's minister for Environment and Planning (1995) and Jones, that construction of dams for hydro schemes hinders the development of

water transportation downstream below the dams (Encarta Encyclopedia Standard, 2005).

Of the responses in the Table, 13.3% indicated that, the hydropower projects were the major causes of massive out-migration in the communities. The respondents strongly felt that the damage caused to the fishing industry in the communities by the dams forced many of the economically active people who were involved in fishing to migrate to other places upstream for fishing. The destinations of this group of the migrants are Yeji, Buipe, Kpandai, Kete Krachi, Kpando, Makango, Sabonjira and Afram Plains (all together popularly known as Dzigbe in the communities). A 106 year old man captured it all by saying that, all his 13 children including 5 women and 8 men left him and his two wives when the long buses destined to Dzigbe came weekly in August 1971. For several years, he had not set eyes on the 4 surviving ones (Field data, 2008). The interviewees also indicated that the 1969 spillage floods that destroyed people's farms and houses compelled many people, including the paramount chief (Togbe Assem) of Mafi traditional area to relocate at Adidome and other places within the traditional area. The out-migration phenomenon has depopulated the communities and in some cases, made the communities disserted and underdeveloped. This is in contradiction with the notion that hydropower schemes promote development of new settlements with well equipped socio-economic facilities in lower river basins for affected people. This assertion was supported with New Bussa constructed of sandcrete block below Kainji Dam in the Niger basin 48 km (30 mi) south to the dam (Pritchard, 1988).

Twelve responses (2.8%) of the 435 (100%) responses given by the 120 respondents in the Table indicated that, there was high prevalence of broken homes in the communities as a direct result of the effects of the projects on people's social and economic activities. Responding further, respondents revealed that, most married men who left their wives behind and went to Dzigbe with the anticipations of coming back for them and their children never came back, while women, who had sweet stories from returnee migrants, left their husbands and joined the fray. In the view of a 98 year old father of 4 women, all his daughters, who were happily married, had their marriages abandoned because their husbands could not perform their duties as family heads due to non existence of regular sources of incomes after the collapse of the fishing industry. This confirms the assertion that the dam construction may have resulted in dislocation of established families and family values when people are forced to move from their original places of abode and resettled in new areas (Areola, et al. 2001).

It is also identified from the Table that, 13 responses (3%) of all the 435 responses provided by the 120 respondents indicated that, the hydroelectric schemes brought poverty to the people in the study area. In support of this position, the interviewees indicated that, poverty is high in the study area because of the collapse of the fishing industry and absence of viable and reliable alternative sources of incomes in the area. These resulted in extremely low level of incomes that were unsustainable, leading to exodus of the youth and husbands or wives, leaving behind elderly people and single mothers or fathers, who have lower-than-average abilities to earn income. A respondent (who happened to be

an opinion leader) noted that, not only do residents earn less income, but the single parents in particular, often have difficult times caring for their children, running households, and earning adequate incomes. It was also noted that lack of educational opportunities for residents of the communities was a cause of poverty in the study area. According to the respondents, lack of education, meant reduced employment opportunities in the other sectors of the national economy. An elderly man summed it all, by saying that, "poverty has been breeding poverty; in some cases, the handicap of poverty is passed from one generation to another in the study area, possibly as a result of the family being caught in a poverty trap". An elderly man in Dugame also put it in this way. "My son, go round the town and look at the nature of people's living places. I tell you, the few blocks and bricks buildings you see belong to citizens, resident outside the community. We cannot send our children to colleges after Junior High School education because of lack of money" (Field data, 2008). This revelation agrees with the position of UNEP 2000 report, known as GEO-2000.

From the Table , 49 (11.3%) out of a total of 435 (100%) responses provided by the 120 respondents indicated that, the 1969 dam spillage floods that destroyed many houses and farms still affect people's status and psyche in the six communities. To date, many people could neither rehabilitate their houses ruined by the floods nor build new ones to replace those lost to the flood waters. Some affected families since then, could not regain their status due to the extent of damage caused to their properties and occupations such as houses, household wares, fishing gears and farms and have since remained in abject poverty. It was

also noted that, many people who witnessed the flood disasters still have the fear that the floods may occur again either through dam spillage or when the dams give in to the pressures of nature. This is in line with growing concern for the safety of many tens of thousands of people who live under the shadow of dams and who would most likely receive no warning if the dam walls were to fail (http//en.Wikipedia.org/wiki/Johnstown_Flood).

The data in the Table also show that trade and commerce in the communities had not been spared by the brunt of the hydropower schemes. Eight response (1.8%) of a total of 435 responses stated that fish, particularly oysters, ('adodi') that served as the local trade commodity, is no longer available in the communities. High level of and regular incomes of the people that created high demands for merchandise goods, gave way to misery of poverty with little or no markets for goods and services in the communities.

It is observed from the Table that 6.7% of the 435 responses provided by the 120 respondents indicated that labour shortage is one of the effects of the hydropower schemes in the six communities. According to them, the exodus of the youth yearly, mainly to Dzigbe and Twifo Praso for fishing and farming since the hydropower schemes came into being, has led to scarcity of labour force needed to employ on their farms. This therefore means high cost of labour in the affected communities.

From the Table, it is found that, 5.5% of the 435 responses stated the spread of water related diseases and sicknesses such as bilharzias, river blindness and malaria in the study communities as the effects of the two dams in the study

communities. As noted in the "Disease Control Unit 2008 Annual Report" of the North Tongu District' Health Directorate (N.T.D.H.D.), water related diseases like bilharzias (Schistosomiasis) and malaria are high in the study area. The report indicated that, out of 3624 suspected cases tested, 2656 were positive of Urinary Schistosomiasis giving a prevalence rate of 73.3% while 10.7% Intestine Schistosomiasis was attained out of 103 suspected cases in 31 river line communities including the study area. The report also stated that, malaria is the number one reported and killer disease among the top ten diseases in the district including the study communities due to large mosquito population in the area. According to the report, malaria cases reported was 48% of top ten diseases in 2006, 23% in 2007 and 48.2% in 2008, while malaria related deaths were 57 in 2006, 57 in 2007 and 59 in 2008. A data indicating the ten top reported ailment cases in the district between 2006 and 2008 is shown in Table 9.

The high rates of water related diseases and sicknesses in the area is in line with the views expressed by Iwena (1996) that, the dwindling volume of water in the lower valley facilitates the spread of water related diseases like bilharzias, malaria and river blindness in the lower basin.

Table 9: Top ten OPD reported ailments in North Tongu District from 2006 to 2008

Ailments reported cases	2006	2007	2008
Malaria	24.738	33.745	53.149
Urinary Tract Infections (URTI)	3560	2500	9578
Hypertension	3260	2900	4444
Gynaecology infections	2703	2800	3331
Diarrhoea	1659	4100	N/A
Anaemia	1647	1550	2091
Skin diseases/Ulcer	1606	2501	4166
Hernia	1246	1300	N/A
Intestinal worm	1215	3200	2967
Pregnant related complication	1078	1607	N/A
Total	52.712	56.203	-

Source: N.T.D.H.D. Disease Control Unit 2008 Annual Report.

The results of the discussions justify the positions of the resident respondents that the hydropower schemes on the Volta River have series of negative effects on the social and economic lives of people in the study communities. Key among the schemes' effects identified in the area are the collapse of fishing industry, trading activities and water transport related businesses as well as the spread of water related diseases and sicknesses.

Effects of hydropower schemes on the river and its immediate environment

In order to evaluate the impacts of the hydroelectricity schemes on the environments in the six Mafi communities, the Environmental Officers of both V.R.A and EPA, were asked whether there was any post project environmental assessments of the hydropower projects in the communities and if yes, they

should state the effects. Responses from the Officers of the two institutions indicated that the schemes resulted in destruction of aquatic life (fish stock), aquatic weeds infestation and exposure of sand deposits in the lower river valley within the six communities.

The resident respondents were also asked to state with evidence whether the dams had significantly affected the river and its natural environments within the lower river basin in the study communities. The respondents mentioned the evidence in Table 10 as the significant negative effects of the dams on the river and its natural environment in the study communities.

Table 10: Effects of hydro-schemes on river volta and it natural environment in the study communities

Dam effects on environment	Frequency	Percent
Volume of river reduced	120	27.3
River flows slowly	119	27.1
Weeds on river and tributaries	119	27.1
Alluvial deposit ceased	2	0.5
River colour becomes reddish	66	15.0
Harmful files and germs breed	13	3.0
Total	439	100.0

Source: Fieldwork, 2008

Table 10 shows that 27.3% of the total responses given by the 120 resident respondents indicated that the volume of the river has reduced drastically since

the dams were constructed upstream. Previous water marks pointed to the author in the river valley compared with the current level of water, showed that the latter is lower than the former by about 2.5metres. This result is in line with the views of Nadar (1970) and Haavisto (1995). According to them, dam construction leads to marked reduction in volume of water in lower river valleys.

It is also shown in the Table that 27.1% of the responses stated that the hydropower schemes led to imperceptible flow of the river in its lower basin within the six communities. The respondents noted that the river was turbulent and a swiftly flowing water that was often seen carrying downstream boulders, capsized boats, dead bodies and other loose materials. They however, indicated that today, until one steps into the water or is sailing on the river, one could hardly notice that the river is flowing. This finding confirmed the position of Areola, Mamman, Omotoso & Omweluzo (2001) that dams constructed upstream disrupt the flow regime of rivers below the dams.

From the Table, 27.1% of responses indicated that waterweeds have colonised the river and its tributaries (like Gbagbawui, Aklamador, Agbenorbu, Kebe) within the communities after the dams were constructed at Akosombo and Kpong. Some of the weed species found on the river were Utricularia Spp, Eichhornia Crassipes, Moss, Panicum Maxima and Scirpus Cubensis (refer to photographs of the weeds in Appendix I). The finding confirms the views of Nadar (1970) that reduction in volume and velocity of water flow in lower river valleys, allows growth of hyacinth vegetation that covers the river surface.

In the Table, 0.5% of the responses show that the river no longer deposits

silt and other sediments on its floodplains. According to the respondents, since the dams were constructed, the river never experienced its usual seasonal flooding that supplied large volumes of silts and flood waters to the floodplains and tributaries respectively within the lower basin. This finding is in line with the position expressed by Waugh (2003) that silt, previously spread over farmland in lower river basins, will be deposited in the lake when dams are constructed for hydropower projects.

Sixty-six responses (15%) of the total responses in the Table indicate that, the river and its tributaries such as 'Gbagbawui', 'Aklamador', 'Agbenorbu' and 'Kebe', now have reddish colour which was not the case before the dams were constructed on the river. In their views, the reddish colour may be due to the continuous decay of vegetation in the water.

Three percent of the evidence shown in the Table indicated that, River Volta and its tributaries breed harmful flies and germs in the study area. According to the respondents, black flies, mosquitoes and water snail became common in the communities since the construction of the dams on the river. To them, the low velocity of the river and its tributaries, growth of waterweeds on the river and streams are the causes of high prevalence of the flies and water snail in the area. This finding proves the assertion that dwindling volume and low velocity of water facilitate the breeding of harmful flies and germs such as black flies, mosquitoes etc that cause river blindness, malaria and bilharzias (Iwena, 1996).

From the findings above, it is clear that the hydropower-schemes at Akosombo and Kpong have damaging consequences for the river and its natural

environment in the lower basin within the six Mafi communities. Within environmental possibilism framework and triangular framework of interrelationships, Blache (1920) and Brunhes (1940) viewed the relationship between human-beings and the environment as one of interdependence and repercussions (people were both influenced by and influenced the environment around them). The triangular framework also provides an understanding of causal relationships of phenomena in indifferent localities. It further stressed that 'new landscapes' develop as a result of interactions between human actions and environmental resources (conditions). In the light of these views, the negative effects of the two dams on river Volta and its environments are the repercussions of the hydropower-schemes in the lower basin including the study area.

Effects of the present socio-economic activities of the people on the environment

With regard to the effects of socio-economic activities of people on the environment, personnel of environmental units of VRA and EPA indicated that they did not believe that socio-economic activities adopted by the people after the dams were constructed have negative implications for the environment and the projects. Therefore, no measures have been put in place to check the impacts of human activities on the environment in the six Mafi communities.

Responses from the North Tongu District Planning Officer and resident respondents on the other hand showed that socio-economic lives adopted in the communities resulted in destruction of vegetation, land and water and as well

changed climate conditions in the study area. According to respondents, activities like farming and firewood and charcoal making, adopted by the people have caused serious deforestation in and around the communities, thereby exposing the river and its tributaries to high rate of evaporation. An elderly woman said it all in this way.

> "My son, when we were young, it was fearful to walk from Aklamador to Awalekpo (Agbenyorkope) and Devime because of how thick and vast the forests were between the communities. We were picking dead branches of trees at the outskirts of the village for firewood but now, we cannot even get firewood for domestic use because of charcoal burners"(Field data, 2008).

Another revelation made by the respondents is serious erosion in the study area. In their views, activities like farming, charcoal burning and in some cases, oyster shell mining have exposed the land to actions of surface run-offs, causing severe sheet and gully erosions in the area. Wide and deep pits were left unfilled after mining oyster shells in parts of the study area.

Eutrophication through discharge of both domestic degradable wastes and agro-chemicals applied on farms along the river and its tributaries was also found to be an environmental effect of human activities in the study area. The respondents indicated that there is heavy application of agro-chemicals such as fertilizers and insecticides by farmers in the communities while subsistence fisherfolks drop bio-degradable items in the river to attract fishes. Some communities also sited their refuse dumps very close to the river. Run-offs often

after rains either washed or leached nutrients from these sources into the river and its tributaries. The result of these practices could be the rapid growth of the water weeds on the water bodies. The shallow waters in the river and its tributaries allow the riverbeds to receive enough sunshine to provide temperature amounts needed for the growth of waterweeds. Therefore, nutrients from the agro-chemicals, refuse damps and drops of bio-degradable items deposited in the river basin facilitate the rapid growth of waterweeds that colonise the river and its tributaries in the study area.

Further responses indicated that human activities contributed to erratic rainfall patterns in the study area. According to the respondents, rainfall seasons and reliability in the area reduced drastically. They believed that the change in rainfall patterns could be attributed to severe deforestation in the area. This belief was based on the fact that forests bring rains. The views expressed by respondents confirmed the positions stated as, people who lost their sources of livelihood like fishing and water transport operations in lower basins, usually turn to exploitation of other natural resources which consequently result in climatic change that invariably affects the lakes behind dams (http://en.Wikipedia.org/wiki/Dam).

People's coping mechanisms in the study communities

To assess mechanisms employed to make lives meaningful for people living in the communities after the hydropower dams were constructed, a number of questions were posed to the North Tongu District Planning Officer and personnel of community development units of VRA and EPA. They were asked to

indicate whether the people were offered any form of compensation, and whether some measures were put in place to check the effects of the projects on the lives of the people in the study communities.

Responses from North Tongu District Assembly noted that, the communities were not considered as victims of the schemes and therefore, no compensations were paid to the people but responses from VRA indicated that the people in the communities were compensated. Responses from both outfits however, indicated that bilharzias control education and immunisation programmes were carried out in the communities. These were confirmed by resident respondents interviewed in the communities.

VRA respondents stated further that studies were undertaken to identify economic potentials available within the communities and the findings were made available for use by community members to enhance their socio-economic status. However, when resident respondents were asked to confirm this, the responses indicated otherwise. In response to a question whether the community had been compensated either before or after the dams were constructed, the resident respondents unanimously indicated no. Resident respondents were also asked to mention socio-economic facilities available in the communities. Responses showed that while Aklamador and Devime had potable water (provided in 2008), electricity (provided in 2005) and basic schools, Dugame had potable water (provided in 2008) and basic schools. The rest (Agbenyorkorpe, Aloryi and Dokpo) had only potable water (provided in 2008).

Resident respondents were also asked to state measures that they adopted

to cope with the effects of the hydropower-schemes. Multiple responses provided are shown in Table 11.

Table 11: Coping measures adopted by respondents

Measures	Frequency	Percent
Subsistence farming	92	36.4
Charcoal burning	49	19.4
Self help water project	2	8
Out-migrated	34	13.4
Petty trading	5	2.0
Food vendoring	17	6.7
Rebuilt own houses	3	1.2
Tailoring	9	3.6
Community clearing weeds	38	15.0
Teaching	4	1.6
Total	253	100.0

Source: Fieldwork, 2008

From Table 11, 92 (36.4%) responses of all the 253 responses provided by the 120 respondents indicated that they adopted subsistence farming to produce food to feed themselves and their household members, leaving non for sale. This confirms the established views that people who lost their sources of livelihood like fishing and water transport operations in river basins, usually turn to farming along the river as their occupation (http://en.wikipedia.org/wiki/Dam). They also stated that foods from the subsistence farms, in some cases, are not able to sustain them throughout the year. According to them, this created perpetual financial difficulty for them and they are therefore not able to provide the needs of their families.

It is also shown in the Table that 49 responses (19.4% of 253 responses) indicated that charcoal burning as an occupation, was adopted by people in the study area to cope with hardships visited on them by the hydropower-schemes. The respondents stated that charcoal burning became the only alternative source of livelihood that provided short term incomes for them when fishing ceased and farming became more difficult and needed sophisticated and very expensive inputs.

They further indicated that wood harvesting for charcoal burning has also caused severe deforestation and loss of forests in the area such that they can no longer get mature trees to fell for charcoal burning. This has led to a drastic reduction in the volume and quality of charcoal being produced. Therefore, charcoal makers now receive very low and unreliable incomes that could not sustain them and their families. Wood harvesting for charcoal burning in the six Mafi communities is in line with the position sighted in http://en.wikipedia.org/ wiki/Dam that people who lost their sources of livelihood in lower river basins due to dwindling volume of water in valleys usually turn to wood harvesting for firewood and charcoal burning as their occupations.

Of the 253 responses provided in the Table, 0.8% shows that self-help mechanisms were adopted to provide some socio-economic facilities in the communities to make life relatively bearable for residents. The respondents indicated potable water and electricity as the projects undertaken in the communities through self-help projects. All the six communities successfully paid for the counterpart funds for the three district (North Tongu, Damgbe East and

Damgbe West Districts) water supply project and were connected to the system in 2008. However, Aklamador and Devime were the only communities in the study area that met their financial commitments in full for the electrification project and were connected to the national electricity grid in 2005 with the rest having only low tension electricity polls erected. This confirms the views expressed that hydropower-schemes promote development of new socio-economic facilities in settlements within lower river basins (Pritchard, 1988).

In the Table, 13.4% of the 253 responses indicated that out-migration was the only coping option adopted to make ends meet. According to them, they migrated to fishing communities along the Volta Lake upstream where they continued with fishing as their original occupation and returned home after they had grown old. Majority of them indicated that they made enough wealth to sponsor their children's education and skill training, and built their own houses which they could not have done if they had stayed at home after the construction of the two dams.

Fifteen percent (15%) of the total responses in the Table indicated that community members in the study area periodically engaged in communal labour to remove waterweeds at some boat berthing points along the river. They removed the weeds in order to sustain at least canoe transport operations between the study communities and also, between the communities and other ones dotted on both banks of the river in the lower basin. Close observations at existing berthing points in the study communities, show narrow and winding/meandering boat routes through the waterweeds on the river to connect open water off the shore of

the river. The observations confirmed the removal of weeds from those parts of the river.

From the analysis above, it can be concluded that the people in the study area adopted a number of coping mechanisms including subsistence farming, self help water and electrification projects, petty trading, food vendoring, rebuilding of their destroyed houses, tailoring and removal of waterweeds that were more sustainable means of survival than wood harvesting for charcoal burning that invariably affected forest cover, rainfall pattern and farming in the study communities. These findings re-enforce the conclusions of the environmental possibilism framework and triangular framework of interrelationships that, resources or challenges in particular geographical settings influence what people do or how people relate for survival and the people's activities and actions in return affect the environment.

CHAPTER FIVE

SUMMARY, CONCLUSIONS AND RECOMMENDATIONS

Introduction

The study examined the effects of the Akosombo and Kpong power schemes on the lives of people and the environment in six selected Mafi communities in the lower basin of River Volta in the Volta Region. Systematic sampling procedure was used to select 120 sample units from a total of 368 household heads in the six communities. The communities and their corresponding samples are Agbenyorkorpe 10, Aklamador 17, Aloryi 13, Devime 34, Dokpo 10 and Dugame 36. Structured interview and questionnaire approaches were used to collect primary data, while descriptive statistics were used in the data analysis.

Summary of findings

The first objective of the study was to compare the occupations and livelihood systems of the people in the communities before and after the construction of the dams, and the findings are:

- that fishing, trading and water transport operations were the main jobs people did as their sources of livelihood in the study communities before the dams were constructed. Farming was done on only subsistence basis to

feed family members while firewood was harvested not for sale but for fish smoking and domestic uses only. Households also mined oyster shells for the foundation of their own buildings. This occupation structure existed in the study area because of the abundance of fish stock particularly oysters, that served as regular and reliable source of incomes and wealth for the people.

- that farming and charcoal burning have become the major occupations of the people in the study area while fishing has now become subsistence job after construction of the dams on the Volta River. Trading and boat operation, even though still in existence, are now on extremely small scale and petty in character; and oyster shells are mined for commercial purposes.
- that the changes in occupation structure in the study area between the periods before and after the dams were constructed, were due to ecological changes in the river and its environment below the dams within the lower river basin including the study area.

The construction of the hydropower schemes affected the socio-economic lives of the people in the study area, and among the effects are the following.

- The hydropower schemes have made farming more difficult and expensive in the study communities. This was attributed to the seizure of regular seasonal floods that deposited silts on farmlands and wetted the farmlands for easy cultivation on the floodplains. Farmers in the communities now

maintain soil fertility through application of chemical fertilizers and also hire the services of tractors for tilling farmlands.

- The fishing activities have reduced from commercial occupation to occasional subsistence activities in the study area as a result of the dams' construction on the river upstream. It was found that the dams prevent fishes from migrating downstream; waterweeds have grown to cover the river, and streams and tributaries that served as spawning waters in the lower basin, have either dried up completely or are colonised by waterweeds;
- The hydropower schemes have placed limits on water transportation operations in the six communities. It was noted that lower volume of water in the river and growth of waterweed on the river after the dams were constructed, hindered operations of water modals particularly ferry, launch and large boats on the river.
- Respondents strongly believed that the hydropower projects were responsible for the massive out-migration in the study communities. They felt that the damage caused to the fishing activities in the communities by the dams, forced many of the economically active people to migrate to other places upstream for fishing. They also indicated that loss of homes, farms and other valuables to the 1969 spillage floods compelled many people to relocate in different parts of the Mafi traditional area.
- The schemes promoted spread of water related diseases and sicknesses such as bilharzias, river blindness and malaria in the study communities. It

was noted by respondents that the waterweeds on the river and its tributaries, breed harmful flies and germs such as black flies, mosquitoes and water snails that cause river blindness, malaria and bilharzias.

- The study found that, the combined effects of loss of traditional jobs and out-migration caused by the hydropower schemes, resulted in dislocation of established families and family values including broken homes in the communities.
- The study also revealed that, the hydropower schemes on the river brought poverty rather than blessing to the people in the study communities.
- It was found that the 1969 dam spillage floods still affect people's status and psyche, making the people to continuously live in fear for its reoccurrence.
- Labour shortage in the study area was revealed as an end product of the hydropower schemes by the study. The continuous exodus of the youth to Dzigbe and other places for greener pastures since the dams were constructed on the river, made labour supplies less as against demand for it in the communities.

Another objective of the study was to assess the effects of the dams on the river and its immediate environment in the lower basin within the study area. The key findings of the study are that:

- the volume of the river in the study area has reduced drastically after construction of the dams on the river. Old water marks in the River Basin

shown to the researcher were several metres higher than the current level of water in the river;

- the hydropower schemes have caused reduction in the velocity of the river within the lower river basin, including the study area due to release of smaller quantities of the incoming water being housed in the dams;
- waterweeds like Utricularia Spp, Eichhornia Crassipes, Moss, Panicum Maxima and Scirpus Cubensis, have been found to colonise the Volta River and its tributaries in the study area;
- the river does not experience seasonal floods below the dams since the second dam at Kpong was constructed and therefore, does no longer feed its floodplains and streams with silts and flood waters in the study area; and
- the schemes resulted in changes in aquatic life in the study area. Fish stock in the river and its tributaries have reduced and there have been increased breeding of black flies, mosquitoes and water snails due to changes in the flow regimes of the river.

The effects of the present socio economic activities of the people in the study communities on the environment are found to be;

- deforestation and land degradation as a result of farming, wood harvesting for firewood and charcoal burning and in some cases; oyster shell mining that exposed the land to actions of surface run-offs, causing severe sheet and gully erosions in the study area;

- eutrophication through discharge of both domestic degradable wastes and agro-chemicals used on farms along the river and its tributaries; and
- erratic rainfall patterns in the study area. The respondents believed that rainfall seasons, amounts and reliability in the study area have changed, due to severe deforestation in the area.

The last objective was to assess people's coping mechanisms in the study communities.

- The study revealed that, bilharzias control education and immunization programmes, were carried out in the communities through the efforts of VRA. VRA also indicated that the authority commissioned feasibility studies into economic potentials available within the communities and the findings were made available for use by community members. The resident respondents however, denied the existence of any such feasibility studies and its finding in the communities.
- It was noticed that Aklamador and Devime had potable water (provided in 2008), electricity (provided in 2005) and basic schools while Dugame had potable water (provided in 2008) and basic schools. The rest (Agbenyorkorpe, Aloryi and Dokpo) had only potable water (provided in 2008).
- People in the study area engaged in subsistence farming to produce food to feed themselves and their families. Charcoal burning became a viable alternative source of livelihood for many people in the study communities when the fishing industry collapsed.

- The people adopted self-help programmes to facilitate provision of socio-economic facilities in the study area to make life bearable for them. Potable water and electricity were some of the benefits of the self-help concept in the study area. The concept also helped the communities to clear waterweeds off some portions of the water surfaces in the river and its tributaries to pave ways for boat operations and fetching of water for domestic and irrigation purposes.
- It was established by the study that many people in the study area had adopted out-migration as the only option available for them to fulfill their individual aspirations and desires and family commitment.

Conclusions

The results of this study have revealed more negative implications than blessings of the hydroelectricity power projects established on the Volta River for people's occupations and livelihood systems, socio-cultural lives and the natural environment in the six selected Mafi communities.

It is evident from the study that, the two hydropower schemes on the Volta River had caused structural changes in the occupations and livelihood systems of the people in the study communities. For example, fishing which was the main economic activity before the dams were constructed has become occasional subsistence activity while farming that was a subsistence activity has become the major source of incomes for the people in the study area.

On the effects of the hydroelectricity power projects on the socio-economic lives of people, it was observed that, the hydroelectricity power projects on the Volta River have significant negative effects than positive effects on the social, cultural and economic lives of the people in the study communities. While the problems of poverty, out-migration, family dislocation including broken homes, labour shortage and water related diseases and sicknesses are prevalent in the study communities as a result of the schemes only two of the study communities were connected to the national electricity grid.

In relation to how the hydropower schemes affect the river and its immediate environment, the discussions established that the hydroelectricity power projects resulted in chains of severe effects on the Volta River and its environment in the study area. Examples of the effects are destruction of aquatic life, aquatic weeds infestation, exposure of sand deposit, degradation of vegetation and climate change in the lower river basin, including the study communities.

The outcomes of the discussions also show that socio-economic activities adopted by people after the two dams were constructed, created serious environmental problems in the study communities. It must be noted that these revelations fall within the environmental possibilism framework and triangular framework of interrelationships, since the environmental problems in the study communities are the end products of the interaction between human activities and the ecological resources in the study communities after the two dams were introduced into the river basin.

The study also found that people in the study communities adopted series of coping mechanisms including farming, out-migration and clearing of weeds on the river to offset the effects of the hydroelectricity power projects on their lives in the lower Volta basin. However, some of the coping measure, such as charcoal burning and subsistence farming are not sustainable means of livelihood.

The above problems are not imaginary but are real, and can be traced to physical evidence in the study communities as well as documentary evidences at the N T D Assembly, VRA and some media houses like Graphic Communications Ltd.

Recommendations

Based on the findings and conclusions of the study, the following recommendations have been made.

Since fishing is one of the traditional occupations of the people in the study communities, it is recommended that the N T D Assembly and VRA should promote aqua-culture in the area. It is also suggested that the N T D Assembly tasks VRA to facilitate establishment of an integrated agri-business, starting from crop cultivation, processing industries and marketing facilities, with out-growers programmes in the communities to provide jobs for the people. These, when implemented, will provide the residents with gainful employments that will ensure regular and reliable sources of livelihood for them and stem the out-migration phenomenon with its associated socio-economic problems in the study area.

Socio-economic facilities such as health post, markets, electricity, well equipped basic classroom blocks and KVIP, are recommended to be provided in the study communities by the N T D Assembly in collaboration with VRA. N T D Administration should also facilitate construction of all weather roads and foot bridges (over the streams in the area) to link the study communities and also to connect the communities to Accra-Aflao trunk road and Mepe, where a first class road ends. These facilities will make the communities attractive to both citizens and non-citizens to live in.

Compensations should be given by VRA to either the communities as separate entities and/or individuals, especially people who lost their properties to the 1969 spillage floods. This will help the people to replace their lost properties and/or provide basic needs for their families.

Waterweeds on the Volta River and its tributaries must be removed and their growths controlled in the study area in particular and in the entire lower river basin in general by VRA in collaborations with government and non-governmental organisations (NGOs), in order to pave way for fishing and water transport operations. Sand deposits exposed in the river should also be removed by VRA in order to make the river deeper for the development of water transport related businesses in the study area. VRA, in collaborations with the N T D Administration, must facilitate reforestation and tree-crops farming programmes in the study communities as means of restoring the lost ecology and regular rainfall patterns.

REFERENCES

Adeleke, B. Ahmed, K. Areola, O. Irueghe, O. & Leong. G. C. (1992). *Certificate physical and human geography for senior secondary schools*. Ibadan, Nigeria: University Press Plc.

Agbenyo, P. K. (1998). *Foreign aid and community development in Ghana*: a case study of Mafi-Kumase community in the Volta Region. Cape Coast: Department of Geography and Tourism, U. C. C.

Amankwaa, O.P.J. (2002). *GHANA: A human geography for secondary schools.* Takoradi, Ghana: St. Francis Press Ltd.

Areola, O, Mamman, M, Onweluzo. F. A. & Omotoso. O. (2001). *Exam focus: Geography for WASSCE & SSCE*. Ibadan: University Press PLC.

Arnd, F, Snacks, N & Martinde, D. E. (2006). *Dam: Structures for water impoundment; hydroelectricity; and environmental impacts of reservoirs*. Retrieved February 17, 2008 from: http://en.Wikipedia.org/Wiki/Dam.

Bantman, B. (2004). *Tarbela dam.* Retrieved September 4, 2009 from: http://en.Wikipedia.org/Wiki/Tarbela_Dam.

Bezanson, D. Gieslbrecht, J. LaFayette, N. Neal, C. & Swann, J. (1997). *Ellen, C. Semple mainpage.* Retrieved July 5, 2008 from: http://www. colorado. edu/ geography/ giw/semple-ec/semple-ec.html.

Bosshard, P. (n.d). *Three gorges dam/international rivers*. Retrieved September 6, 2007 from: www.internationalrivers.org/china/three-gorges-dam.

Browen, A., & Pallister, J (2002). *Understanding GCSE geography*. Halley Court, Jordan Hill, Oxford: Heinemann Educational Publishers.

Bunnett, R. B. & Okunrotifa, P. O. (1986) *General geography in diagrams for West Africa.* Hong Kong: Longman Group Ltd.

Colman, M. Gaiza, C. Houston, T. Novok, J. Vanaga, A.& Zhou, M. (1997). *Ellsworth Huntington mainpage*. Retrieved July 5, 2008 from: http://www.colorado.edu/geography/giw/huntington-e/Huntington-e.html.

Daily Graphic, July 19, 2007. (p16). Accra, Ghana. Graphic Communication Groups Ltd.

Encarta Encyclopedia Standard 2005.

FilnkoBi, C. (2006). *Three gorges dam: Project layout, economics and environmental effects*. Retrieved July 10, 2008 from: http://en.Wikipedia.org/wiki/Three_Gorges_Dam.

Hogan, T. Andrews, B. & Nicklas, S.(n. d). *Johnstowm floods/ great flood of 1889*. Retrieved july 6, 2008 from: http://en. Wikipedia.org/ wiki/johnstown_Flood.

Holt, Rinnehart & Winston.(1995) *World geography today*. Austin, New York: Harcourt Brace & Company.

Iwena O.A. (1996). *Essential geography for Senior Secondary Schools*. Ogba, Ikeja, Nigeria: Tonad Publishers Ltd.

Leonard, G. (2006). *Glen canyon dam: Structure, operations and reservoir water Allocation.* Retrieved April 7, 2008 from: http://en.Wikipedia. Org/Wiki/Glen_Canyon_Dam.

National Fisheries Association of Ghana. (2004). *Types of fisheries (Inland fisheries)*. Retrieve January 2, 2009 from: http://www. nafagfish.org/ fisheries.htm.

North Tongu District water and sanitation plan, 2007.

Owereko, M. (2003) *Regional geography of West Africa*. Achimota, Accra: Mozey Publications Ltd.

Pritchard, J. M. (1988) *AFRICA: A study geography for advanced students* Hong Kong: Longman Group Ltd.

Profile of North Tongu District, 2005.

Sarantakos, S. (1988). *Social research*. Australia: Charlse Sturt University.

Stahlhoefer, H. & St-Amant, M. (2007). *Itaipu dam: Construction, wonder of the world, social and environmental impacts*. Retrieved September 30, 2008 from: http://en.Wikipedia.org/Wiki/Itaipu_Dam

Trekphiler, (2008). *Dam summary: Dam in cross section, dam types, construction elements, common purposes, sitting and impact assessment*. Retrieved December 12, 2008 from: http://www.bookrags.com/wiki/Dam.

UNEP-2000 report: *Our present course is unsustainable-postponing action is no longer an option*. Nairobi, Kenya: Earthscan publications.

Waugh, D. (2003). *The new wider world*. Delta Place, 27 Bath Road, Cheltenham GL53 7TH UK: Thomas Nelson & Sons Ltd.

APPENDIX I

Figure 2: Photographs of waterweeds on River Volta in the study area.

APPENDIX II

Figure 3: MAP OF NORTH TONGU DISTRICT SHOWING THE STUDY COMMUNITIES

APPENDIX III

INTERVIEW GUIDE FOR RESPONDENTS IN THE STUDY COMMUNITIES

Introduction

Good day, Gentleman/Lady. My name is Prosper Agbenyo, a student of University of Cape Coast. I am conducting a study on the effects of hydro-electricity schemes on the Volta River on the lives of people and the environment in Agbenyorkorpe, Aklamador, Aloryi, Devime, Dokpo and Dugame in the lower Volta River Basin of the Volta Region.

The purpose of the study is to fulfill the requirements of University of Cape Coast for the award of M.A. Degree in Environmental Management and Policy.

You are assured of confidentiality of information you will provide. Information gathered from you will be combined with those provided by other respondents so that your responses to the questions cannot be linked to you.

Please, try and provide your responses as objectively as possible.

Questions

General issues.

1. Sex (a). Male (b). Female

2. Age……

3. What is your level of education? a. No education (b). Basic level.
(c). Secondary level (d). Tertiary.

4. Are you aware of the hydro-electricity projects on River Volta at Akosombo

and Kpong? (a). Yes (b). No .

Effects of the hydro schemes on the socio-economic lives of people in the six communities

5. What were (was) the main jobs of the people in the community before Akosombo and Kpong dams were constructed?

(a). Farming (b). Fishing. (c). Trading. (d). Lime production.

(e). Harvesting of firewood and charcoal making. (f). Boat operations on the river.

6. Do you think, the dams have any significant effects on people's social and economic lives in the community? (a). Yes. (b). No.

If yes, mention the effects……

……

7. What type of effect(s) do you think the dams have on the jobs of the people?

(a). Positive effects. (b). Negative effect. (c). No effects.

Give evidence of the effects of the dams on you occupation.

……

……

8. Which of the job(s) had been affected by the dams' constructions?

(a). Farming. (b). Fishing. (c). Trading. (d). Lime production.

(e) Harvesting of firewood and charcoal making. (f) Boat operations on the river.

9. What job(s) do people currently do in the community?

(a). Farming. (b). Fishing. (c). Trading. (d). Lime production.

(e). Harvesting of firewood and charcoal making. (f). Boat operations on the

river. (g). Teaching.

10. Which of the jobs do you do? ……

11. Do you believe that the community is depopulated? (a). Yes. (b). No.

12. Do you think the effects of the dams are the causes of high level of out migration in the community? (a). Yes. (b). No

If yes, how ……...

…… …… …. .

If no, then what are the causes……..

……...

Effects of the scheme on the Environment

13. Do you think the dams have any significant effects on the river and its natural surroundings? (a). Yes. (b). No.

If yes, what are they? ……

(a). The volume of the river has reduced. (b). The river now flows slowly.

(c). Weeds have grown to cover parts of the river. (d). None of the above.

(e). State any other.

14. How have the changes affected you?

(a). We suffer from guinea worm.(b). We suffer from mosquitoes/malaria.

(c). Fishing activities have collapsed. (d). Berthing points for boats and ferries are covered by water weeds. (e). River blindness is now common in the community.

(f). Bilharzias (g). State any other.

15. Name the types of fish which were common in the river before the dams were built on the Volta river……

16. Are those fishes still common in the river? (a). Yes (b). No.

If no, why……

…….

Effects of socioeconomic activities of people on the environment

17. What effects does your occupation have on the environment?

(a). Trees are cut down. (b). Land becomes bare. (c). Promotes erosion.

(d). Creation of hollows in the land. (e). Chemicals discharged into the river and other water bodies.

18. Do you agree that rainfall amounts and durations have reduced significantly? in the area over the last 15-20 years? (a) Yes (b) No.

19. Do you believe that deforestation may be the cause of reduction in rainfall amounts and rainfall durations in the communities?

(a). Yes (b). No.

Coping mechanisms and benefits of the schemes in the communities.

20. Do you benefit from the hydro-scheme on the river?

(a). Yes. (b). No.

If yes, name the benefits……

……

21. Has any programme(s)/project(s) been put in place to reduce the effects of the Hydropower-scheme on the people since the dams came into being?

(a). Yes. (b). No.

If yes, name the projects……

……

22. Had the community been compensated either before or after the dams were constructed? (a). Yes. (b). No.

If yes, in what form(s)……

…….

23. Which of the following do you have in the community?

(a). Potable water. (b). Electricity.(c). Hospital/clinic. (d) Primary/Junior High School. (e). Senior High School. (f). Market. (g). None of the above.

24. What do you think should be provided in the community to reduce the sufferings of the people?.....

……

25. What measures have you adopted to cope with the effects of the Hydropower-Schemes on your life? ……..

……

26. Are there other things you would like to share with us?

....……

……..……

…….

APPENDIX IV

QUESTIONNAIRE FOR VOLTA RIVER AUTHORITY, ENVIRONMENTAL PROTECTION AGENCY AND NORTH TONGU DISTRICT ASSEMBLY

Introduction

This questionnaire is aimed at gathering information for the study of effects of the hydropower schemes on the Volta River on the lives of people and the environment in six selected Mafi Communities in the lower Volta River Basin of the Volta Region.

The purpose of the study is to fulfill the requirements of University of Cape Coast for the award of M.A. Degree in Environmental Management and Policy.

You are assured of confidentiality of information you will provide. Information gathered from you will be combined with those provided by other respondents so that your responses to the questions cannot be linked to you.

Please, try and provide your responses as objectively as possible.

Questions

Q1 What is your position in this establishment? ……..

……

Q2 Were there any environmental and socio-economic impact assessment studies conducted on the projects in the lower basins before the dams were constructed? (a). Yes (b). No.

Q3 If yes, what were the possible effects of the projects identified in the six

communities on the a) river and its environment?

Positive effects

i)……. ii)……..

iii)…… iv)……..

v)…… vi)……

Negative effects

i)…… ii)……

iii)…… iv)……

v)……. vi)……

a) socio-economic lives of the people?

Positive effects

i)…… ii)……

iii)…… iv)……

v)…… vi)……

Negative effects

i)…… ii)……

iii)…… iv)……

Q4 Has there been any post project environmental and socio-economic impact assessments of the hydro-projects in the six communities?

(a). Yes (b). No.

Q4.1 If yes, state the actual effects of the projects on the

a) river and its environment

Positive effects

i)…… ii)……

iii)…… iv)……

Negative effects

i)…… ii)……

iii)…… i v)……

b) socio-economic lives of the people

Positive effects

i)…… ii)……

iii)…… iv)……

Negative effects

i)…… ii)……

iii)…….. i v)……

Q4.2 If no, don't you believe that the projects have affected the river and its environment in the six communities? (a). Yes (b). No.

If yes, state the effects of the projects on the

a) river and its environment in the six communities,

Positive effects

i)…… ii)……

iii)…… iv)……

Negative effects

i)…… ii)……

iii)…… i v)……

b) socio-economic lives of the people in the six communities.

Positive effects

i)…….. ii)……

iii)…… iv)……

Negative effects

i)…… ii)……

iii)……. iv)……

Q5. Have the people in the six Mafi communities been compensated for the projects? (a). Yes (b). No.

Q5.1 If yes, in what form(s)?

……

……

……

Q5.2 If no, what efforts has your outfit made to minimize the negative effects of the projects on the lives of the people in the six communities?

……

……

……

Q6. What measures have been put in place to check the effects of the projects on

the river and its environment in the six communities?

……..

……

……..

Q7. Do you agree that the economic activities adopted by the people in the six Mafi communities after the dams were constructed have negative environmental implications? (a). Yes (b). No.

Q7.1 If yes, state them

……

……..

Q8. Do you think the environmental implications of human activities can negatively affect the hydropower-project? (a).Yes. (b). No.

Q8.1. If yes, in what ways?

……

……

Q9. What measures have been put in place to check the environmental effects of human activities in the six communities on the projects?

……

……

Q10. Is there any other information you would like to share with me?

……

……