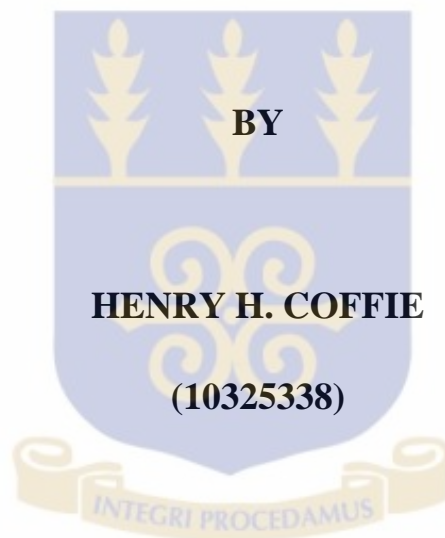


**UNIVERSITY OF GHANA**

**DEPARTMENT OF GEOGRAPHY AND RESOURCE  
DEVELOPMENT**

**A SPATIO-TEMPORAL ANALYSIS OF THE INCIDENCE OF  
SCHISTOSOMIASIS (BILHARZIA) IN THE DANGME EAST AND  
SOUTH TONGU DISTRICTS IN THE LOWER VOLTA BASIN**



**THIS THESIS IS SUBMITTED TO THE UNIVERSITY OF GHANA,  
LEGON IN PARTIAL FULFILLMENT OF THE REQUIREMENT  
FOR THE AWARD OF MASTER OF PHILOSOPHY GEOGRAPHY  
AND RESOURCE DEVELOPMENT DEGREE**

**JULY, 2015**

## DECLARATION

The work in this thesis was conducted by the undersigned candidate while enrolled in the Department of Geography and Resource Development, University of Ghana, Legon. No part of this thesis has been previously submitted to another university for the award of a degree.

I certify that any help received in writing this thesis and all sources used have been duly acknowledged.

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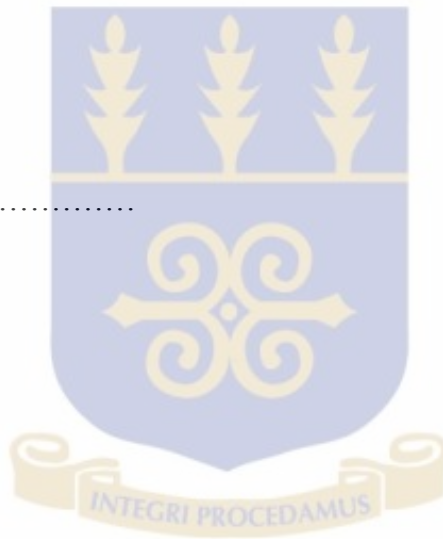
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## **DEDICATION**

This research work is dedicated to my late mother, Madam Elizabeth R. Boss Eдорh and all those who in diverse ways contributed to its success, especially my own student and church member, Mr. Johnson Selorm Abayi and my beloved niece, Worlanyo Akushika Horloroku for their invaluable assistance during my post graduate studies, at University of Ghana, Legon.



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## ABSTRACT

The study examines the spatio-temporal incidence of schistosomiasis in the Dangme East and South Tongu districts of Ghana. It also examines the perceptions of the local people about the disease and discusses the preventive measures and coping strategies adopted. The Triangle of Human Ecology Model was the main theoretical framework employed for the analysis, while a questionnaire survey and in-depth interviews were used to collect data.

The study shows that the incidence of schistosomiasis in the South Tongu District is still very high, but the prevalence of the disease in the Dangme East district has declined since 2010, as a result of educational campaigns. In both districts, the incidence of the disease was highest among children and males than female adults. While children are infected as a result of swimming and fetching water, men are exposed to disease causing organisms through economic activities such as fishing, clam and shrimps harvesting, boat transportation services and swimming. The high incidence of the disease in the study districts were attributed to environmental conditions as well as the construction of the Akosombo and Kpong dams which created the environment for this disease.

Most of the local people knew the causes and symptoms of the disease. Apart from the health effects of this disease, respondents explained that the disease affected them economically as they are required to spend huge sums of money on treatment. Respondents adopted a variety of measures and strategies to cope and manage the disease. These include hospital attendance, boiling of water for domestic use, and avoidance of contaminated water bodies as well as the use of water purifiers for the treatment of water for domestic use. Other forms of coping processes adopted were consultation of traditionalists and use of herbal products together with shrine and spiritual assistance. The prevalence of the disease can be reduced through intensive public education, provision of safe drinking water, and improvement in health facilities and sanitation practices.

**TABLE OF CONTENTS**

<b>Content</b>	<b>Page</b>
DECLARATION .....	i
DEDICATION .....	ii
ACKNOWLEDGEMENTS .....	iii
ABSTRACT.....	v
TABLE OF CONTENTS.....	vi
LIST OF TABLES .....	xi
LIST OF FIGURES .....	xiii
CHAPTER ONE .....	1
INTRODUCTION .....	1
1.1 Background to the Study.....	1
1.2 Statement of the Problem.....	3
1.3 Aim and Specific Objectives of the Study.....	6
1.4 Research Questions .....	6
1.5. Hypotheses .....	7
1.6. Significance of the Study .....	7
1.7 Limitations of the Study.....	8
1.8 Organization of the Study .....	9
CHAPTER TWO .....	11
LITERATURE REVIEW .....	11
2.1 Introduction.....	11
2.2 Definition and History of Schistosomiasis .....	11

2.3 Human Schistosomiasis Epidemiology.....	13
2.4 Transmission and life cycle of schistosomiasis .....	16
2.4.1 The Schistosome Life Cycle .....	17
2.5 Signs and Symptoms of Schistosomiasis.....	18
2.6 Environmental Factors and Schistosomiasis Transmission.....	20
2.7 Seasonality of Schistosomiasis Prevalence.....	29
2.8 Socio demographic factors and schistosomiasis prevalence.....	30
2.9 Health-Seeking Behaviour for Schistosomiasis-Related Symptoms .....	33
2.10 Prevention and control of schistosomiasis.....	35
2.11 Elimination of Schistosomiasis.....	36
2.12 Conceptual Framework.....	37
CHAPTER THREE .....	40
RESEARCH METHODOLOGY.....	40
3.1 Introduction.....	40
3.2 The Choice of Study Areas .....	40
3.2.1. Characteristics of the Dangme East District .....	41
3.2.1.1: <i>Location and Drainage</i> .....	41
3.2.1.2: <i>Climate and Vegetation</i> .....	43
3.2.1.3: <i>Economic Activities, Services and Health Care Services</i> .....	43
3.2.2. Characteristics of South Tongu District.....	46
3.2.2.1: <i>Location and Drainage</i> .....	46
3.2.2.2: <i>Climate and Vegetation</i> .....	46
3.2.2.3: <i>Economic Activities and Health Care Services</i> .....	47

3.3. Methodology .....	50
3.3.1. Research Design.....	50
3.3.2 Research Instruments used.....	51
3.3.2.1 Questionnaire Survey.....	52
3.3.2.2 Pilot Study: Pre-testing of questionnaire .....	54
3.3.2.2 Population .....	54
3.3.2.3 Sample and Sampling Procedure for Questionnaire Survey .....	55
3.3.3. Interviews.....	57
3.3.4 Data Analysis Procedure.....	57
CHAPTER FOUR.....	59
BACKGROUND CHARACTERISTICS OF RESPONDENTS AND SPATIO- TEMPORAL ANALYSIS OF SCHISTOSOMIASIS CASES IN THE DANGME EAST AND SOUTH TONGU DISTRICTS.....	59
4.1 Introduction.....	59
4.2 Socio-Demographic Characteristics of Sample Population.....	59
4.2.1. Background Characteristics of Sample Population.....	60
4.3 Incidence of the schistosomiasis among survey respondents .....	62
4.3.1 The Relationship between Age and the Experience of Bilharzia .....	64
4.3.2 The Relationship between Gender and the Experience of Bilharzia .....	66
4.3.3. The Relationship between Educational Level and the Experience of Bilharzia	68
4.4. SPATIO-TEMPORAL ANALYSIS OF SCHISTOSOMIASIS CASES BASED ON HOSPITAL RECORDS .....	69
4.4.1 Reported cases of Schistosomiasis Disease in health centres within Dangme East and South Tongu Districts .....	70

4.4.2 Relationship between Age and Risk of Schistosomiasis infection .....	72
4.4.3. A GIS Analysis of Reported Cases of Schistosomiasis in the Dangme East and South Tongu Districts .....	74
4.5 An Analysis of Factors Responsible for Schistosomiasis Dangme East and South Tongu Districts.....	80
4.6. Anthropogenic behaviours and the Incidence of the Schistosomiasis Disease.....	83
4.7 Chapter Summary .....	85
CHAPTER FIVE .....	86
KNOWLEDGE, PERCEPTIONS AND MANAGEMENT OF SCHISTOSOMIASIS DISEASE .....	86
5.1. Introduction.....	86
5.2 Knowledge about the disease.....	86
5.3. Coping Strategies and Management of schistosomiasis by Patients and Victims..	94
5.3.1. Treatment of disease .....	94
5.3.1.1 Age and mode of treatment.....	95
5.3.1.2 Sex and Mode of Treatment.....	97
5.3.1.3 Educational Level and Mode of Treatment .....	98
5.3.1.4 Income Level and Mode of Treatment.....	99
5.3.1.5 Last Treatment Time of the Disease .....	101
5.4 Impact of schistosomiasis Infection on Individuals in Endemic Communities .....	103
5.4.1: Economic Effects of schistosomiasis in South Tongu and Dangme East district .....	103
5.4.2 Socio-cultural Impacts of schistosomiasis Infection in Dangme East and South Tongu Districts.....	105

5.4.3 Effects of schistosomiasis on Education of Children .....	106
5.4.4 Impact of schistosomiasis Infection on Health of Patients .....	108
5.5 Suggested Measures of Controlling Schistosomiasis .....	109
5.6 Chapter Conclusion.....	110
CHAPTER SIX.....	112
SUMMARY, CONCLUSIONS AND RECOMMENDATIONS.....	112
6.1 Introduction.....	112
6.2 Summary of Main Findings .....	113
6.3 Conclusions.....	117
6.4 Recommendations.....	118
REFERENCES .....	120
APPENDIX A: Research Questionnaire for the Household of the Head/Representative in Study Areas.....	131
APPENDIX B: Chi-Square Tests B: Chi-Square Tests between Age and the experience of bilharzia.....	139
APPENDIX C: Table showing documented cases of schistosomiasis of the various health facilities.....	146
<b>APPENDIX D: Interview Guide for People Living in the Study Area.....</b>	<b>149</b>

**LIST OF TABLES**

Table 3.1a: Categories of persons.....	56
Table 3.1b: Categories of persons.....	56
Table 4.1a: Demographic characteristics – Age distribution.....	61
Table 4.1b: Demographic characteristics – Sex distribution.....	61
Table 4.1c: Demographic characteristics – Educational level.....	61
Table 4.1d: Demographic characteristics – Occupation.....	62
Table 4.2: Respondents who ever experienced Schistosomiasis.....	63
Table 4.3: Frequency of Attack of Schistosomiasis.....	63
Table 4.4: Age and the experience of Schistosomiasis.....	65
Table 4.5: Chi-Square Tests between Age and the experience of bilharzia.....	65
Table 4.6: Sex and the experience of bilharzia.....	67
Table 4.7: Chi-Square Tests between Sex and the experience of bilharzia.....	67
Table 4.8: Educational level and the experience of Bilharzia.....	68
Table 4.9: Chi-Square Tests between Educational level and the experience of bilharzia .....	69
Table 4.10 a: Distribution of Schistosomiasis Cases in the Dangme East District by Age (2009-2011).....	71
Table 4.11: Number of times of contact with contaminated water.....	83
Table 5.1: Knowledge of most important factor on how Bilharzia is contacted.....	86
Table 5.2: Knowledge on most important mode of contracting bilharzia.....	88
Table 5.3: Chi-Square Tests between Age and how bilharzia is contacted.....	88
Table 5.4: Sex and knowledge on most important mechanism of contracting bilharzia .....	89

Table 5.5: Educational level and knowledge about how bilharzia is contacted .....	90
Table 5.6: Chi-Square Tests between Educational level and how bilharzia is contacted .....	90
Table 5.7: Most important symptom of bilharzia infection .....	91
Table 5.8: Knowledge of the organism responsible for the transmission of bilharzia	92
Table 5.9: Factors which contribute to the high incidence of bilharzias (Multiple responses) .....	93
Table 5.10: Mode of treatment of schistosomiasis attack.....	95
Table 5.11: Age and mode of treatment.....	96
Table 5.12: Chi-Square Tests on Age and mode of treatment.....	96
Table 5.13: Sex and mode of treatment .....	97
Table 5.14: Chi-Square Tests on Sex and mode of treatment.....	98
Table 5.15: Educational level and mode of treatment .....	99
Table 5.16: Chi-Square Tests on Educational level and mode of treatment.....	99
Table 5.17: Income level and Mode of Treatment.....	100
Table 5.18: Chi-Square Tests on Income level and Mode of Treatment.....	101
Table 5.19: Last Treatment Time.....	102

## LIST OF FIGURES

Figure 2.1: The life cycle of the schistosome .....	17
Figure 2.2: Influence of Environmental and Demographic Factors on Schistosomiasis Disease Burden.....	39
Figure 3.1: Map of Ghana showing the study areas in Yellow and deep Brown colours; Dangme East and South Tongu respectively.....	41
Figure 3.2: The Sub-District Map Health Map of the Dangme East District .....	45
Figure 4.1: Levels of documented schistosomiasis cases in Dangme East and South Tongu Districts in 2009 and 2010. ....	75
Figure 4.2: Levels of documented schistosomiasis cases in Dangme East and South Tongu Districts in 2011 and 2012. ....	77
Figure 4.3: Levels of documented schistosomiasis cases in Dangme East and South Tongu Districts in 2013 and 2014. ....	79
Figure 5.1: Perceptions of effects of contracting bilharzia .....	94
Figure 5.2: Coping Strategies and Management of Schistosomiasis.....	102
Figure 5.3: Effect of bilharzia on economic activity .....	104
Figure 5.4: Expenditure on bilharzia management .....	105

## CHAPTER ONE

### INTRODUCTION

#### 1.1 Background to the Study

It has been estimated by the World Health Organization (WHO) that up to 80% of ill health in the developing countries is water and sanitation related (WHO, 2012). Many water sources in developing countries are unhealthy because they contain harmful physical, chemical and biological agents (Bosompem, Bentum, Otchere, Anyan and Brown et al., 2004). Four main routes by which water – related infections are transmitted are water – borne route, water – washed route, insect vector route, and water – based route (Paul & Johnson, 2011).

In the case of water – borne route, humans become infected by ingesting pathogenic bacteria, viruses and parasites in water polluted by human or animal faeces or urine. Resultant diseases in this category include cholera, typhoid and rotavirus diarrhoea. Water- washed route diseases are associated with scarcity of water for personal hygiene (e.g. bathing, hand-washing) laundering and washing of cooking utensils. Notable water – washed route diseases include scabies, skin ulcers, typhus and relapsing fever. The insect – vector route infections are associated with phenomena where humans become infected by being bitten by insect vectors which breed in and around water bodies. Diseases in this category include: Malaria, Yellow Fever, Dengue (Mosquito-borne), Trypanosomiasis (Riverine tsetse fly) and Onchocerciasis (Black flies). Water-based route diseases are associated with parasites that require a snail host, fish or other aquatic animals in which to develop. Human beings become infected by ingesting the infective forms or by infective forms that penetrate the skin. Infective forms of diseases which penetrate the skin are the schistosomiasis species (Kogulan & Lucey, 2007).

While water borne diseases have affected man for millennia, their prevalence has increased in the developing world within the past few decades, as a result of the construction of many large multi-purpose water impoundments (Larbi, 2013), which tend to extend the environmental and habitat factors which support the spread and survival of the infectious parasites (Xue, Gebremichael, Ahmad, Weldu & Bagtzoglou, 2011). There is enough evidence to suggest that Schistosomiasis (also known as Bilharzia) is one of the most widespread parasitic infections that is associated with the construction of large scale dams (Apuusi, 2012). The disease is the second most prevalent and pervasive tropical parasitic disease and a leading cause of morbidity and death after malaria in its endemic areas of Asia, Africa, South America, the Middle East and the Caribbean (WHO, 2012).

Schistosomiasis is a chronic, debilitating and critical tropical parasitic disease for which no preventive vaccine has yet been found (Bosompem et al., 2004). Schistosomiasis has for ages traumatized large proportions of rural populations globally, especially in endemic tropical developing countries where the rural populace has little or no access to potable water and therefore remains highly vulnerable and susceptible to schistosomiasis infection. The disease has adverse economic and health implications for populations living in endemic areas as well as visitors to such hazardous areas. Schistosomiasis significantly remains an important cause of morbidity and mortality in tropical zones, where climatic and physical environmental factors support the survival and flourishing of host zoonosis vectors such as snails. Globally, about 200 million people are infected with *Schistosoma* species in 74 tropical countries. Similarly, about 500-600 million people are at risk of the infection due to exposure to four main species of schistosomiasis and their various intermediate snail hosts. The infection rates are highest among children. The

disease, which affects both man and livestock, is caused by digenetic trematodes or blood flukes of the family schistosomatidae (Kogulan & Lucey, 2007).

While the disease is found in many parts of the world, its effects are more serious in sub-Saharan Africa where about 131 million people are infected (Bosompem, 2004). In Ghana, schistosomiasis tends to be endemic in communities with low hygienic standards, education and without proper sanitation facilities. The high prevalence of schistosomiasis in Ghana was attributed to the creation of the Akosombo Dam in 1964, the construction of small dams and reservoirs in other parts of the country and the resultant population movement (Larbi, 2013). Given the health and socio-economic problems associated with this disease, this study examines its incidence and management in the Dangme East and South Tongu Districts of Ghana.

## **1.2 Statement of the Problem**

Schistosomiasis is a problem of public concern in many African countries, including Ghana. In Ghana, the disease is an important occupational hazard associated with fishing and farming. In addition, large numbers of people, especially children are infected as a result of recreational activities like swimming (which involves mostly children) and domestic activities like fetching of water for washing, drinking, bathing and cooking (Larbi, 2013). The high prevalence of this disease in Ghana is attributed to the creation of dams for development purposes (Bosompem *et al.*, 2004). Even though *S. haematobium* (an agent of the disease) was reported in the Volta Basin of Ghana before the construction of the Akosombo Dam in 1964, it was not considered a disease of public health importance since the prevalence and intensity were low. The prevalence rate in Kete Krachi and Yeji as well as their surroundings were less than three percent.

However, three years after the construction of the dam, the prevalence was 73 – 84 % in Kete Krachi and 64 – 76% in Yeji (Paperna, 1969). This clearly indicated that the construction of the dam led to a significant increase in the prevalence of schistosomiasis in these areas. Following the construction of the Kpong Dam, similar events occurred, and the predominance of schistosomiasis infection increased among villagers living adjacent to the newly created head pond, in the village of Kpong (Sady *et al.* 2013).

According to Ayeh-Kumi (1996) schistosomiasis is known to occur in all regions in Ghana, especially among the riparian communities, some of which have registered prevalence rates as high as 100% for urinary schistosomiasis. A questionnaire survey on urinary schistosomiasis carried out in 1989 as part of the Ghana's guinea worm eradication project revealed that out of 17, 320 villages visited 5,947 (34.3%) had urinary schistosomiasis. Long term chronic illnesses that result from infection have serious consequences for the country's socio-economic development. There are life-long damages to the liver, lungs, intestines and the urinary bladder. Usually, complications involve cardiopulmonary, gastro-intestinal and urinary tracts along with urinary obstruction and eventual death.

While a number of studies have been conducted on the prevalence of this disease in the 1980s and early 1990s (Larbi, 2013), its prevalence and management in specific localities in contemporary times have not been comprehensively examined. A thorough look at the various comprehensive scholarly studies undertaken by earlier scholars and institutions, including the Lower Volta Basin Research Project of the University of Ghana, focused on the biological causes of the disease (see for instance, Hunter, 1992; Bosompem *et al.* 2004), leaving a vacuum of economic empowerment of the affected

communities. This study, therefore, examines the spatio-temporal distribution of the disease in the Dangme East and South Tongu Districts of Ghana. The study also examines the perceptions of local people about the disease as well as the coping strategies adopted by victims to deal with the disease.

The choice of the Dangme East and South Tongu Districts for this study is very significant given the fact that these two districts are replete with environmental factors that promote and support breeding and thriving of the snail host which transmits the disease. Both districts are along the Volta River, and are characterised by marshes and other factors that favour the organisms that spread the disease. The people of Dangme East and South Tongu are predominantly fishermen, farmers and animal herders. These activities keep them constantly in contact with water; hence the incidence rate of the disease is high and widespread.

The two districts share similar environmental conditions with the Volta River serving as the boundary between them. It is, therefore, important to understand how social-environmental and behaviour interaction with health and disease play out in the two districts, given similar environmental settings. Spatial patterns of diseases are not only important but intricate and complex and the spatial distribution of diseases can uncover important information of disease transmission. Intensity and timing of schistosomiasis transmission is essential for local epidemic control and management. On this basis it is useful to ask the question: what environmental factors promote the prevalence of schistosomiasis and which behavioural factors underpin the existence of schistosomiasis in both study areas?

### **1.3 Aim and Specific Objectives of the Study**

The main aim of the study is to undertake a spatio-temporal analysis of the occurrence of schistosomiasis in the Dangme East and South Tongu Districts. Specifically, the study shall seek to:

1. Examine the spatial and temporal patterns of the incidence of schistosomiasis in the study areas.
2. Identify the environmental factors that promote the prevalence of schistosomiasis in the endemic study areas.
3. Evaluate the anthropogenic behavioural factors that underpin the existence of schistosomiasis in both study areas.
4. Examine the knowledge and perceptions of the local people about the schistosomiasis disease in their communities.
5. Examine the preventive measures and coping strategies adopted by people in the study areas to deal with schistosomiasis.

### **1.4 Research Questions**

The study attempts to answer the following questions.

1. What is the prevalence rate of the schistosomiasis disease in the study areas?
2. Which environmental factors account for the spread of schistosomiasis in the study areas?
3. What anthropogenic behaviours underpin the incidence of the disease?
4. What is the level of the people's knowledge about the disease (schistosomiasis) in the study areas?
5. What type of correlation exists between gender and the incidence of the disease?

6. What type of management strategies do people adopt to cope with the schistosomiasis disease in the study areas?

### **1.5. Hypotheses**

The following hypotheses have been formulated to guide the research.

1. Ho: There is no significant relationship between gender and the incidence of schistosomiasis.  
H1: There is a significant relationship between gender and the incidence of schistosomiasis.
2. Ho: There is no significant relationship between age and the incidence of schistosomiasis.  
H1: There is a significant relationship between age and the incidence of schistosomiasis.
3. Ho: There is no significant relationship between educational level and the incidence of schistosomiasis.  
H1: There is a significant relationship between educational level and the incidence of schistosomiasis.
4. Ho: There is no significant relationship between income level and mode of treatment of schistosomiasis.  
H1: There is a significant relationship between income level and mode of treatment of schistosomiasis.

### **1.6. Significance of the Study**

The research will produce enough scientific information about the selected communities in terms of the incidence of schistosomiasis in the two study districts which may

undoubtedly contribute to the knowledge of the disease and how to manage it among the affected people. The findings of the research will also encourage the people in the areas of study to change their attitudes and behaviour in relation to their practices as far as their daily encounter with the river is concerned. Additionally, the findings will help in educating the vulnerable people who are likely to have this disease, and also health officials in designing strategies to assist the people concerned. Other researchers in water borne diseases may also rely on the findings as a guide for further studies into the incidence of water related diseases and their effects on human development especially in our country sides.

Another significance of this research lies in the fact that it deals with spatio-temporal analysis. Among three fundamental elements (person, place and time) of disease outbreak investigations, both space (geography) and time are two main components (Moore *et al.* 1999, cited in Yan, 2013). Geography can offer useful inklings to understand social-environmental and behaviour interaction with health and disease. Spatial patterns of diseases are not only essential but complex and multifaceted and the spatial distribution of diseases can reveal significant facts about disease transmission (Zhou *et al.* 2009, cited in Yan, 2013). The outcome of this study will be useful for local epidemic control and management.

### **1.7 Limitations of the Study**

The limitations of the study among others included the following.

1. Unwillingness of respondents to provide information about the state of their sickness.
2. Paucity of data on cases of schistosomiasis in the two main district directorates of medical services in the study areas.

3. High level of illiteracy in the study areas affected the quality of responses both in the questionnaire and the interview sessions.
4. Language barrier of the researcher made response interpretation difficult at some stages of the interview. The main language spoken in the Dangme East is Dangme, which the author could not speak and it therefore hindered interpretation in the field.
5. However, the challenges were resolved with reference to the specific limitation area. The unwillingness of respondents to provide information on the status of their disease was overcome by assuring them that this information will not be divulged to anyone. Further, knowledge of the disease by the government will inform the government to provide more health services and support to the infected people. Data paucity was resolved through finding averages to the existing data to provide a continuous trend in information. Language problems were also resolved through an interpreter to the researcher.

### **1.8 Organization of the Study**

The research report is organised into six chapters. The first chapter deals with the introduction which includes background to the study, problem statement, research questions, as well as hypotheses, objectives of the study, the significance of the study and limitations as well as delimitations. Chapter Two, which is pivoted on literature review, unfolds scholarly works of other people based on the topic. The third chapter, which is the methodology, consists of the research design and instruments for data collection and analysis. Chapters four and five are devoted to the presentation and analysis of data. While Chapter Four primarily focuses on spatio-temporal analysis of the disease, Chapter Five deals with the perceptions of the people and the coping strategies

adopted to deal with the disease. The final chapter is limited to conclusion, summary and recommendations as well as suggestions for further research.

## CHAPTER TWO

### LITERATURE REVIEW

#### 2.1 Introduction

This chapter reviews empirical works of scholars in the field of medical geography with specific focus on works involving the schistosomiasis disease. This review focuses on the definition of schistosomiasis, human schistosomiasis epidemiology, transmission and life cycle of schistosomiasis, signs and symptoms of schistosomiasis, environmental factors and schistosomiasis transmission, seasonality of schistosomiasis prevalence, socio-economic and demographic factors and schistosomiasis prevalence, health-seeking behaviour for schistosomiasis-related symptoms, the prevention and control of schistosomiasis and elimination. This section also includes the conceptual framework for the study.

Literature for the study comprised both primary and secondary data sources. In addition to this, the literature was reviewed by consulting materials from varied sources including electronic and manual. The researcher personally visited institutional libraries, health facilities in the two districts as well as searching electronic libraries to identify relevant literature.

#### 2.2 Definition and History of Schistosomiasis

Nkegbe (2010a) described schistosomiasis as infection with *Schistosoma* trematode flat worms or flukes that are transmitted by fresh water snails. Further, the researcher explained that blood in urine signifies infection by *Schistosoma haematobium* and blood in stool by *Schistosoma mansoni*, with each one having its intermediate snail host which facilitates the transmission of infective stage to man. Schistosomiasis is a term used to

refer to a complex set of severe and chronic parasitic infection triggered by mammalian blood flukes (schistosoma) (Alika, 2013). According to the WHO (2010), it is an illness that is caused by parasites (genus *Schistosoma*) that enter humans by clinging to the skin, penetrating it, and then travelling through the venous system to the portal veins where the parasites produce eggs and ultimately, the signs of acute or chronic disease (for example, abdominal discomfort, blood in stools, blood in urine and painful urination). These infections are transferred by aquatic or amphibious snails in an extensive variety of freshwater habitats. Of the 16 classes of schistosome known to infect humans or animals, only five are accountable for the vast proportion of human infections: *Schistosoma haematobium*, *S. intercalatum*, *S. mansoni*, *S. japonicum* and *S. mekongi* (Alika, 2013).

Schistosomiasis in Africa, is an ancient infection, as evidenced by a description of haematuria in a papyrus about 3000 B. C. and the finding of calcified eggs in Egyptian mummies dating back to 1250 B. C. (Klumpp, 1983). According to Klumpp (1983), until the 20th century, transmission on the continent was confined to limited foci in the Nile basin, mainly in seasonal irrigation canals; in the forest and savannah regions, mainly in streams, small rivers, natural lakes, and ponds. The rapid increase of population in the 20th century and the opening up of the continent with permanent roads radically altered the ecological equilibrium between man and the parasite. Dams had to be built in large numbers to conserve water and feed expanding irrigation schemes. By the roads came more settlements, reservoirs, culverts, and ponds. The infection moved rapidly into these new ecological niches.

In a study of the transmission of *Schistosoma haematobium* in the Volta Lake of Ghana, Klumpp (1983) further observed that the most serious development which accelerated the spread of schistosomiasis in arid parts of Africa was the change from basin to perennial irrigation. This was especially widespread in Egypt and Sudan. There, the lifeblood of agricultural production was the annual flooding of the Nile. Formerly, dikes and embankments held enough of the flood water for one annual crop to develop in low lying fields. But this type of agriculture could not meet the demand for more food and cash crops. The shift to perennial irrigation originated in the Nile basin late last century and spread slowly up the Nile. Large reservoirs were built to store flood water and prevent widespread inundation of the fields. The stored water was released slowly and steadily to the fields through vast networks of earth-lined canals, allowing a succession of crops throughout the year. Snail population quickly infested the irrigation networks: *Bulinus truncatus* in the canals and *Biomphalaria alexandrina* in drains in the Nile delta. One of the largest epidemics of *S. haematobium* and *S. mansoni* in the world had begun. The completion of the first Aswan dam in 1902 and its heightening in 1933 led to the rapid spread of perennial irrigation and *S. haematobium* infection to Upper Egypt.

### **2.3 Human Schistosomiasis Epidemiology**

The epidemiology and epidemiological changes of schistosomiasis are varied and complex, involving a definitive host in the human, an intermediate host in various species of aquatic or amphibious snails, a freshwater setting that humans contaminate with excreta through unhygienic practices, and from which the infection is also developed through recurrent water contact by means of many work-related and recreational events (Hunter, 2003). People get infected with schistosomiasis by coming into contact with contaminated water containing schistosome parasites while engaging in

such activities as bathing, swimming, or performing everyday household tasks, including laundry, herding animals and fetching water. To this extent, patterns of hygiene, water delivery, and human water usage are critical factors in identifying the risk of infection (USAID, 2014).

After malaria, Schistosomiasis is the second most significant origin of parasitic disease in terms of public health impact (Steinmann et al., 2006). Nearly 800 million persons are indicated to be exposed to schistosomiasis, and over 600 million of these are found in Africa (King & Dangerfield-Cha, 2008). The WHO has estimated that over 200 million people in Africa are plagued with the illness but possibly less than 15% of these are treated for the disease (WHO, 2012). Geographically, the distribution of the various schistosome types follows the distribution of the respective intermediate hosts. *S. haematobium* is common in the Middle East and Africa, *S. mansoni* in the Caribbean, South America, Africa, and the Middle East, and *S. japonicum* in the Philippines, China, and Indonesia. *S. intercalatum* and *S. mekongi* are present in limited areas of sub-Saharan Africa and Southeast Asia, respectively. Such artificial environmental alterations as irrigation and the movement of infected people further contribute to the epidemiology of schistosomiasis. The three main human schistosome species cause different pathologies. Chronic infections with *S. mansoni* and *S. japonicum* lead to intestinal schistosomiasis, whereas *S. haematobium* causes urinary schistosomiasis (Apuusi, 2012). In Ghana, schistosomiasis according to Apuusi (2012), is triggered largely by *Schistosoma haematobium* and *S. mansoni*. The eggs in urine or stool cause diarrhea, liver fibrosis, portal hypertension, obstruction uropathy, renal failure and cancer of the bladder.

Research has revealed that the disease is associated with poverty, with resultant poor housing, absence of clean water, insufficient hygienic environments, few if any sanitary facilities and several activities bringing people into contact with water into which eggs are delivered and in which are found intermediate host snail hosts (Steinmann *et al.*, 2006; Engels *et al.*, 2002). Obligatory human water contact may be of domestic, hygienic, occupational, recreational or religious origin. These obligatory human water contacts include cooking, drinking, bathing, washing, farming, fishing, masonry, swimming, wading and religious washing of the body-ablution and baptism (Alika, 2013).

Children are predominantly prone to infection due to their indiscriminate excretory practices, particularly urination when swimming, and their unparalleled opportunities for water contact in hot climates (Alika, 2013; Steinmann *et al.*, 2006). Alika (2013) suggested that Schistosomiasis is not invariably a rural disease because increasing populations in periurban fringes of cities engulf the available sanitation and are thus at risk of transmission in modern cities of Africa and northeast Brazil.

According to the USAID (2014), Schistosomiasis infection is common in childhood as children tend to engage more in bathing or swimming in water carrying the larval form of the parasite. Incidence and prevalence of infection rise with age, climaxing in the age group between 5 and 14. Poor growth and decreased mental development are especially suffered by children as the most side effects of the disease. The disease also leads to undernourishment and interrupts school attendance. Among adult people, there is a severe deterioration in intensity of infection but not in the prevalence of the ailment.

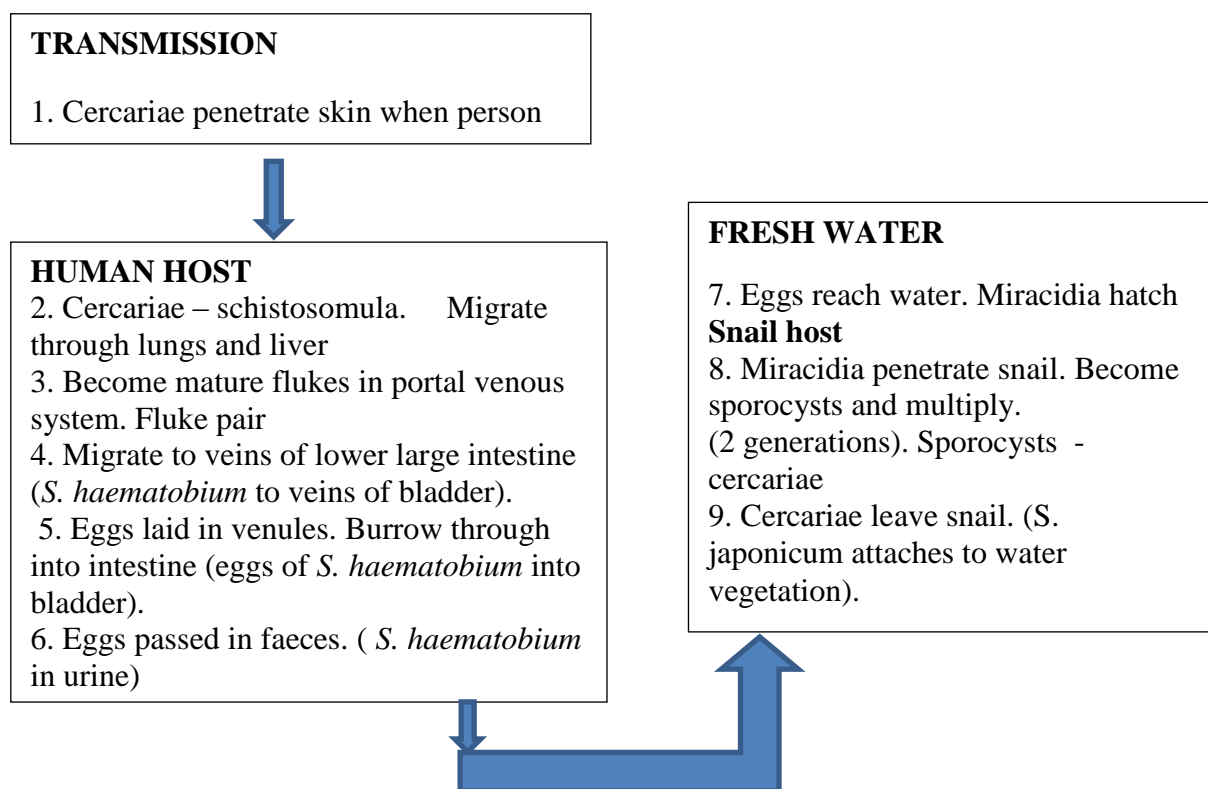
## **2.4 Transmission and life cycle of schistosomiasis**

As shown in Figure 2.1, the spread of schistosomiasis needs three conditions:

1. A source of infection for the contamination of fresh water with human urine or faeces containing schistosome eggs. In the two districts at the centre of this study fresh water bodies are common in the study area and the communities use the water for fishing, domestic activities and irrigation of farmlands where infected human urine or faeces can contaminate through urination or when used as manure.
2. The presence in the water of the right species of the snail such as *Biomphalaria*, and *Bulinus* which live under water and cannot usually survive elsewhere and also *Oncomelania*, an amphibious snails adapted for living in and out of water.
3. Human contact with water by bathing, wading or washing in it or drinking. In the study communities, human contact with water by these means occur during agricultural activities (farming and fishing) and fetching water from the canal and lakes for domestic purposes such as building houses and for animals to drink.

Man is the main source of infection, children who pass large numbers of eggs being the main source. This occurs during farming, fishing, swimming and intentional direct urination in fresh water bodies by children (Alika, 2013).

### 2.4.1 The Schistosome Life Cycle



**Figure 2.1: The life cycle of the schistosome**

The miracidia, which are viable only in fresh water, seek and attach themselves to Schistosomiasis host snails to which they are specifically adapted and penetrate their tissues by means of a cephalic gland to form sporocysts. Each snail can be infected by multiple miracidia. The sporocysts develop for a period of 4 -7 weeks within which they differentiate into the second larval stage (cercaria). The production and release of cercaria from infected snails into water occur daily, sometimes for periods exceeding eight months (Jourdan & Theron, 1987). The optimum conditions for cercariae shedding are reported to be strong sunlight and water temperature of 25 – 30°C.

The cercaria penetrates the intact skin of a susceptible mammalian host and transforms into a schistosomula which enters the lymphatic vessels or veins and are transported via the circulation through the right side of the heart and lungs. From here some pass into the

circulatory system to reach the mesenteric vessels while others pass directly through the diaphragm to reach the liver and portal system (Mclaren & Smithers, 1987). The period from penetration by the cercariae to egg laying by adult worms is 30-40 days or more.

Growth of schistosomula into adult worm takes place in the liver, where some paired worms may be found after 26 days. *Schistosoma haematobium* worms migrate into the vesicle plexus, while *S. mansoni* and *S. japonicum* worms migrate to the mesenteric veins. The mated worms move as far as possible forward toward the terminal vessels where the female leaves the male and progress to the smallest part of the vessel to deposit its eggs and then retreat. The eggs penetrate the endothelium of the blood vessels into the tissues where majority of them are trapped and the remainder excreted from the body through the urine (*S. haematobium*) or faeces (*S. mansoni* and *S. japonicum*).

In the case of urinary Schistosomiasis peak egg excretion in humans is reported to occur between 10.00 and 14.00 hours as against the early hours of the morning for intestinal Schistosomiasis. The Schistosomiasis prevalence rates and intensity of infection are reported to be higher in children around the ages of 15-18 years probably due to the higher rate of contact with infested water through swimming, bathing and fetching for domestic purposes (Mott, 1987).

## **2.5 Signs and Symptoms of Schistosomiasis**

According to the USAID (2014), many people show no symptoms when they are initially infected with schistosomiasis. Nonetheless, a person who gets infected with the disease may develop a rash or itchy skin within days of getting infected. Within a period of 1 to 2 months of infection, flu-like signs may emerge. Symptoms of severe and protracted

schistosomiasis infection are triggered by the body's reaction to the parasites' eggs, which become lodged in the intestine or bladder, causing swelling or scarring. In children, infection can trigger anemia, malnourishment, and learning complications.

With urinary schistosomiasis, the parasites' eggs impair the bladder and kidneys, which causes agonizing urination, blood in the urine, and abdominal pain. Intestinal schistosomiasis destroys the intestines and liver, producing abdominal pain, fever, and blood loss. Impairment to the liver can create inflammation of the abdomen, which is a typical sign of infection. Symptoms of severe schistosomiasis include abdominal pain, inflamed liver, blood in the stool or in the urine, and difficulties passing urine; it can also increase the risk of developing bladder cancer.

Among women, urogenital schistosomiasis may trigger genital abrasions, bleeding through the vagina, pain during sexual contact, and lumps in the vulva. In men, urogenital schistosomiasis can bring about pathology of the seminal vesicles, prostate, and other organs. This infection may also have other long-term protracted irreversible implications, including infertility. In rare instances, eggs are found in the brain or spinal cord and can cause seizures, paralysis, or spinal cord inflammation.

Intestinal schistosomiasis produces blood in stool or (bloody) diarrhea, abdominal uneasiness or pain and colicky cramps. Secondary indications of fever, weakness, fatigue, anorexia and weight loss are frequent (Alika, 2013). Adults, who typically have light infections, are often asymptomatic but some develop late pathology after prolonged infection (King & Dangerfield-Cha, 2008). In such circumstances it is hard to identify the presence of schistosomiasis and this may develop into severe complications as the

disease continues to advance. Other investigators found out that female and male genital schistosomiasis decrease fertility and may stimulate the spread of HIV/AIDS (Kallestrup, Zinyama, Gomo, Butterworth & Mudenge *et al.*, 2005). Some authors too indicate that the general liveliness and academic performance of children infected is affected in school (McGarvey, 2000) and these could be identified as indications of schistosomiasis in rural endemic societies.

## **2.6 Environmental Factors and Schistosomiasis Transmission**

Schistosomiasis (bilharzia) is one of the key work-related ailments acquired by man through activities connected with freshwater such as bathing, washing, leisure and recreation as well as fishing (Schistosomiasis Factsheet, 2011). In Brazil, for instance, schistosomiasis mansoni infection is an endemic disease that largely affects the population in the countryside who engage in domestic and social activities in rivers and water bodies that provide living quarters for the snails of the disease (Gomes *et al.*, 2012). It has also been recognized as a disease of substantial socio-economic and public health significance, next only to malaria. It is instigated by the blood fluke *Schistosoma haematobium* (the species that generates blood in urine) and *Schistosoma mansoni*-the species that causes blood in the stool (Tay, Amankwa & Gbedema, 2011).

Ecological changes that are caused by water development schemes can ease the transmission of schistosomiasis or the introduction of the diseases into hitherto non-infected zones. Specifically, the creation of dam reservoirs and the execution of irrigation schemes frequently lead to an extension of the habitats of intermediate host snails, and hence new prospective transmission sites for schistosomiasis (Steinmann *et al.*, 2006). Steinmann *et al.* (2006) cited several water development schemes in Africa to

buttress their conclusion. In Côte d'Ivoire, Ghana, and Nigeria, the construction of large dam reservoirs was followed by the introduction of urinary schistosomiasis or an upsurge in its occurrence among inhabitants living in close proximity to these water bodies. Two studies, one from Sierra Leone and one from the Democratic Republic of the Congo, acknowledged the introduction of *S. mansoni* into areas hitherto free of the disease following mining operations. The establishment of open water bodies was perhaps the fundamental reason.

Transmission of schistosomiasis to humans occurs when the cercaria penetrates the skin of people who normally wade, swim or make any form of contact with tainted water. The tiny worms travel through the body until they advance into sexually developed adults, and lay eggs in about 25 to 30 days of infection (Xue et al., 2011). Some of the eggs are delivered out of the body in the stool (*S. mansoni*, *S. japonicum*) or urine (*S. haematobium*) to carry on the parasite life cycle.

Larbi (2013), citing the 2004 Medical Ecology report noted that under tranquil environmental and climatic settings in fresh water, the eggs hatch into larvae known as miracidia and later enters the appropriate snail host, grow and discharge hundreds of minute worms known as cercariae. Given suitable water volume and flow, these cercariae travel about quickly for a number of days after they are let loose from the snail. Within this time, when they come into contact with vulnerable human skin, they get attached and abandon their tails, and enter the skin to carry on the cycle (Larbi, 2013). The remaining eggs which about half of the total are locked in body tissues, causing an immune reaction and progressive destruction to organs (Xue et al., 2011).

Xue et al. (2011) has indicated that rainfall and temperature are the climatic elements that have been known to produce significant instability to the regular rhythms of snail population dynamics. Exceedingly high temperatures make snail reproduction reduced (Malone, 2005). Thus when the amount of water in water bodies are low as a result of reduced rainfall, they become susceptible to being heated to temperatures above 50°C. According to Hunter (2003), in irrigation systems, the occurrence and timing of water transfer into the channels also has an effect on snail populations.

The effect of environmental alteration on the expansion of intermediate host snail species has been widely studied. This is shown in the work of Odongo-Aginya, (2008) in which it was stated that laboratory studies have showed that all the three genera of snail hosts can tolerate a wide temperature range. Whereas at low temperatures, snails are dormant and have low fecundity but good survival, egg production and snail mortality rise proportionately with rising temperature. As temperature rises above the ideal range, the period within which the schistosomiasis parasite (cercaria) stays energetic in the water becomes less. This in turn declines the infection rate of the parasites, resulting in lower incidence (WHO, 2012).

In the work of Zhou et al. (2010), the effects of temperature on prevalence and development of schistosomes have been indicated to have been studied in the laboratory by a number of authors, where they found that the rate of development increased with temperature as a linear relationship. The appropriate type of temperature for larval increase in the laboratory was between 15°C to 35°C. Similarly, McNally (2001, cited by Larbi, 2013) also reported a least temperature condition of 15.3°C and an optimal of 22°C for *S. haematobium*. On the other hand, an opposite relationship between rate of

advancement and temperature above the ideal temperature was detected by Mangal et al., (2005), cited in Larbi, 2013). The research by Malone (2005) also reported that the optimum temperature for the development of *S. mansoni* is 20–27°C and that the cercariae remain infective for 5–8 hours once they are produced under optimum temperature conditions, and this interval becomes shorter under bad temperature settings. The maximum temperature (T<sub>max</sub>) reflects the warmest daytime temperatures, while the least temperature (T<sub>min</sub>) reflects the coolest nighttime temperatures (Intergovernmental Panel on Climate Change, 2001). In an effort to developed a biology-driven model to assess the possible effect of increasing temperature on the transmission of schistosomiasis in China, a temperature threshold of 15.4°C for development of *Schistosoma japonicum* within the intermediate host snail (i.e. *Oncomelania hupensis*), and a temperature of 5.8°C at which half the snail sample investigated was in hibernation were found (Zhou et al., 2008).

Githeko et al. (2000) in a research in Uganda, indicated that unlike the previous reports which indicated no transmission of schistosomiasis at the height higher than 1,400m above sea level, it was reported that schistosomiasis transmission was taking place at an altitude range of 1487–1682 m above sea level in western Uganda. It was predicted in that research that the change in the geographic range could be due to climatic factors and recommended further research to ascertain whether or not the observed altitudinal threshold change is as a result of climate change. The authors also found that Schistosomiasis cases have recently begun showing up in high-altitude (greater than 2000 m above sea level) regions, which were traditionally not endemic. Xue et al., (2011) in a different research in irrigated farming region in Ethiopia using Satellite temperature and precipitation, found that temperature and precipitation play a role in the

spread of schistosomiasis. They established a weak but significant positive correlation between monthly maximum temperature and the number of schistosomiasis patients. In the same study they also recognized a significant negative correlation between monthly precipitation volume and the reported cases. These associations were observed at lags of 1 and 2 months for the temperature and rainfall respectively. Thus, changing temperatures and rainfall patterns have consistently been reported to influence the reproductive cycles and behaviours of disease vectors, leading to a more suitable environment for the spread of disease and the potential for the emergence of new ones (United Nations Economic Commission for Africa (UNECA), 2005). The host snail of genus *Ribeiroia*, for instance, have their eggs developing four times faster at 26°C than at 17°C and did not develop at 12°C (Scarлата et al., 2005). Higher temperatures increased snail growth, egg production but extreme temperatures results in mortality (Paull and Johnson, 2011). Woolhouse et al., (1990) describes the fecundity rate as being dependent on temperature by modeling a bell curve relationship with the optimum temperature peak at 20.6°C. The host snails, for example, do not usually lay eggs at temperatures below 18°C (Larbi, 2013).

Other studies have also found that the egg laying behaviour of the snails rises proportionately with temperatures up to 30°C (Larbi, 2013; Malone, 2005). Likewise, some scholars have also placed the ideal temperature range from 22-25 and the ideal humidity in the range 55-70% (Larbi, 2013). The difference in the temperature range is because of the different snail genus and species involved in the disease transmission and also the geographical location of the study sites. However, it is normally accepted that rainfall and temperature are very important elements for the transmission of the disease. Above 35°C, snail and egg mortality is reported to rise dramatically (Larbi, 2013;

Hunter, 2003). Malone (2005) also added that the temperature of water bodies governs the growth rate of the parasites within snails and the infectivity of cercariae. Thus, this temperature-dependent increase in the development of infected snails together with the cessation of parasite expansion at lower temperatures indicates that rising temperatures will alter the host–parasite dynamics. This means that future climate change could modify parasite abundance and distribution (Paul & Johnson, 2011).

There are several ways by which precipitation can influence the transfer of schistosomiasis. These include: increase in surface water which can offer breeding sites for snails (Hunter, 2003). Low precipitation can also increase breeding locations by decelerating river flow (Odongo-Aginya et al., 2008). Vectors which are reliant on vegetation may get expansion in population because increase rain encourages vegetation growth. Moreover, flooding may remove habitat for both vectors and hosts by dispersing them. (Larbi, 2013). Xue et al., (2011) made it clear that intense rainfall frequently results in greater runoff which end up in ponds and irrigation canals, and thus generating high flow velocities and turbulent shear that may kill the schistosomes. For instance, flooding in the Yangtze River has been reported to produce approximately, a threefold decrease in acute cases of schistosomiasis per annum compared with years of normal water levels (Larbi, 2013).

Lack of rain on the other hand may increase the frequency of water contacts due to the need to get water from infested ponds (Ugbomoiko *et al.*, 2010). Schistosoma species have been found to vary considerably in their preferences for amount of rainfall, length of the rainy and dry seasons, and interval between rainy and dry seasons. It has been reported by a number of researchers that, the factor that has the greatest effect on

freshwater snail population dynamics in the tropics is rainfall (Larbi, 2013; Odongo-Aginya *et al.*, 2008). Flooding due to excess rainfall can trigger turbulence in snail habitats, as annual floods have been found to drown adult snails. Widespread floods have a considerably negative consequence on snail inhabitants (Larbi, 2013). At regions with continuous flooding, some snail classes live about one year but where less common or no inundation, the species can live at least twice as long, and often longer. Water level and speed also affect the snail populations, with high water currents, the snails are moved downstream to a habitation of lower current (Larbi, 2013).

Xue *et al.* (2011), in their study, reported that precipitation and temperature are significant drivers of malaria and schistosomiasis transmission. They recognized that precipitation is principally responsible for creating the conditions that permit enough surface water accumulating in ponds and creating abundant snail breeding sites. The temperature of water bodies influences the rate of development of the parasites within snails and the infectivity of cercaria. Cercaria remains infectious for 5–8 hours once they are released under optimal temperature circumstances, and this period becomes smaller under non-optimal temperature settings. Long period of time without rain causes some of the natural snail habitats dry out for a considerable part of the year, leading to the death of a large number of the snails, despite their ability to withstand drought (Stensgaard *et al.*, 2011). However, due to the extremely high reproductive ability of these snails their habitations are rapidly repopulated in a matter of six weeks after the rains (Larbi, 2013). Thus precipitation is favourable for the development of the snail populations, but the excess of it which causes inundations tends to scatter the snails and hence diminish their population (Larbi, 2013). However, the precise process and precipitation amount where there is a change from increasing snail reproduction as against decreasing cercariae

activity or dispersal of snails is not clear in the literature (Xue et al., 2011). Studies on the population dynamics of some snail species have shown the instability of snails' populations is associated with the variations in seasonal, climatic, and ecological factors (Larbi, 2013).

This variety of paths results in rain not having the same consequence across communities and areas. Thus some studies have found a negative relationship between precipitation and schistosomiasis occurrence (Xue et al., 2011) while others report the opposite (Samie et al., 2010). Thus there could be other local and community-specific intermediating ecological, social, behavioural and physiological factors affecting the climate change and schistosomiasis prevalence nexus.

Research identifies several environmental factors potentially creating the enabling setting for the breeding of the snail as well as the pupal and larval parasites and hence leading to schistosomiasis spread and infection. Larbi (2013) relying on the 2010 Medical Ecology report categorized these factors under the social, natural and built habitats. The landscape of an area has been recognized to play a major role in shaping the concentration of snail habitats, especially for wetlands that lie above low water level of lakes and rivers. Periodic standing ponds are typical of these higher areas. Odongo-Aginya (2008) and Stensgaard et al. (2011) recognized that flat land with dry-season ponds and streams with thick grass covering the ground form ideal snail habitations. Other places found to provide the setting appropriate for snails include shallow shores with little or no variation in water levels and drainage canals with high levels of agricultural runoff. Dams, ponds and irrigation canals also to a great extent stimulate the disease abundance (Nkegbe, 2010).

In the Volta River basin in Ghana, for instance, prior to the damming in 1964, occurrence of urinary schistosomiasis was below 5% among communities living along the River. However, after damming, by 1971 many communities living along the lakeshore had registered high prevalence rates of between 80 - 90%. In 1989 infection rates of 76.2% for *S. mansoni* and 6.3% for *S. haematobium* were recorded (Larbi, 2013). The construction of a pond or dam comes with mixed developments. As noted by Steinmann et al., (2006) and Stensgaard (2011) construction of a dam and the formation of reservoir on a river could have both positive and negative impact on schistosomiasis transmission and control. As regards the positive influence, the creation of the large dams could reduce the frequency and the intensity of floods in the river and hence a decrease in the dispersal of snails and the chances of infection for humans. The floods could also inhibit the growth of snails (Zheng et al., 2002). The undesirable effects seem to be vast because apart from the fact that the flushed beaches may become snail habitations, the rising of the water body level may cause expansion in the snail habitats at some places as well. Also the beach may offer the conditions ideal for the growing of reed-grass for an extended period of time and thus benefiting the reproduction of the snails (Zheng et al., 2002).

Urban growth, deforestation and farming practices can have an effect on the density of most snail species (Aagaard-Hansen *et al*, 2009). This is because poor sewage systems and lack of latrines and potable water which is typical of urban slums create local diffusion sites (Larbi, 2013). Also, huge slums and squatter zones around towns and cities are characterized by overcrowding and very poor hygienic conditions and thus providing a conducive atmosphere for the disease transmission (Bruun and Aagaard-Hansen, 2008). With regard to deforestation, Larbi (2013) mention that generally

drought and desertification resulting from deforestation decreases vector breeding as most disease vectors depend on aquatic environments and drought conditions severely curtail the vector longevity. With regards to agricultural practices, in areas where there is effective use of pesticides there is resistance among the vectors to the pesticides and has major consequences on disease transmission. In addition, the rains tend to wash these pesticides from the crops and farmlands into the river bodies and thus having dire consequences on the survival of disease vectors.

### **2.7 Seasonality of Schistosomiasis Prevalence**

Regarding seasonality of the disease prevalence, Tay, Amankwa and Gbedema (2011) found that maximum incidence occurs in January (15.4%) and the least in March (3.4%). However, in their research prevalence was uneven between April and December, and was in the range of 5.86% and 10.19%. They also observed a general three-year pattern of *S. haematobium* peaks of infection during the period under review with infection happening throughout the year. Larbi (2013) also reported that transmission of *S. mansoni* was shown throughout the year in a man-made dam, whereas transmission of *S. haematobium* in a stream only occurred in the dry season. This is in consonance with the findings of Chandiwana et al., (1987, cited in Larbi, 2013) who indicated that transmission of *S. mansoni* was unpredictable and erratic and has no clear seasonal transmission pattern. On the contrary, *S. haematobium* showed a periodic pattern, with improved intensity in the hot and dry months (September to November) and markedly reduced during the cold and dry months, thus the June-August season in his conclusions. Also, modest and mutable, but infrequently intensive observations were made during the December-February and the March-May seasons. This is no different from the report of Etim et al. (1998, cited in Larbi, 2013) that the snail vector populations fluctuate

strongly, decreasing at the peak of the rainy season. Thus decreasing snail population would mean decreasing infection rate. In corroboration to the higher prevalence in the dry season, Tay, Amekudzi and Tagoe (2011) and Bavia et al. (1999,) also reported higher occurrence in the November- April season. Clearly, there are differences in the seasonality of schistosomiasis prevalence across study locations. This suggests that there may be other local factors relating to the habitat, population and behaviour as specified in Larbi (2013) possibly causing the regional and community differences in the seasonality of schistosomiasis occurrence.

## **2.8 Socio demographic factors and schistosomiasis prevalence**

In a study on the prevalence and associated factors of schistosomiasis among children in Yemen, Sady et al. (2013) identified several socioeconomic conditions which facilitate the spread of the disease. The authors concluded that the fetching of water and living near water bodies such a stream or a pool of water were major risk factors for schistosomiasis. According to them water storage, streams, dams and pools may all provide conducive breeding locations for snails and therefore, possibly, sustain the transmission of schistosomiasis in these zones. The study further identified schistosomiasis as a poverty-related disease and their findings showed that children belonging to families with a low household monthly income were 2.3 times more likely to be infected as compared to their counterparts belonging to families with a higher household monthly income. They also recognized in their study, that the absence of an operational toilet in the house was significantly associated with the prevalence of schistosomiasis. A related significant association of schistosomiasis with using unclean water for domestic chores and other family purposes was also found in the study.

In a review of socioeconomic studies of schistosomiasis in Brazil, Kloos et al. (2009) indicated fishing and other agricultural activities to be significantly correlated with *S. mansoni* incidence and intensity of infection in most rural populations. Moreover, bathing in and domestic contacts with water bodies, living in deprived housing conditions, lack of potable water, toilets and shower facilities, low educational attainment, and being born in rural areas were all found to be significantly associated with *S. mansoni* prevalence. Another important social aspect explored in the study was migration. In spite of largely better living circumstances in urban than in rural areas, schistosomiasis has a moderately high incidence in many Brazilian cities because of relocation of infested people from endemic rural areas and existence of transmission sites and even the creation of new snail habitats in the urban setting.

Sex has been found to play a foremost role in the prevalence of the disease. Many researchers have reported a consistently higher infection rate in males than their female counterparts (Tay *et al.*, 2011, Nsowah-Nuamah *et al.*, 2001). For instance from the findings of Nsowah-Nuamah *et al.*, (2001), the infection rate among the males was as high as 55.9% as against the 3.7% in the females. Contrary to these findings, Nkegbe, (2010) found a rather higher prevalence among the females (64%) than the males (21.8%). This was attributed to the numerous water contact activities of females as a result of inevitable domestic chores that the females undertake which compel them to enter the river to fetch water. However Mafiana et al., (2003) in a study in Nigeria found no significant difference in the infection rate between males and females. These observations are expected considering the fact that some socio-cultural practices such as farming, fishing and recreational activities tend to expose males to infected water bodies than the female counterparts. Besides, these contradictions could be due to the different

circumstances prevailing in the study communities. For instance in communities where the females are responsible for fetching water and washing clothes in the river, female infection rate is likely to be higher compared to places where swimming as a recreational activity is dominant or where fishing from streams or irrigational farming using water from ponds prevail (Mafiana et al., 2003).

Age is another important demographic variable reported to be associated with schistosomiasis prevalence. It has been shown that the highest prevalence lies in the age range 5-25 (Xue et al., 2011). Aboagye and Edoh (2011) for instance, found that as high as 78% of those infected were between the ages 5 and 15. Similarly, Xue *et al.*, (2011) reported a prevalence of 87.3% and 84.1% respectively among children in the age groups 8-11 and 12-14. This is something to be concerned about because these are people in the formative ages of their lives and this infection could be very detrimental to their growth and development.

Population density is another factor that has been associated with schistosomiasis prevalence. Watts (2006) also explains why globalization and urbanisation coupled with population movements is having influence on the incidence of schistosomiasis. The author argues that rural people bring the diseases with them to the rapidly expanding population centres. Then the unsafe sanitation and water supplies, plus unchanged behaviour facilitate the establishment of disease transmission in urban slums. The main mechanism is that movement leads to fresh exposure to the infectious agents – either because the migrating population moves into new areas and gets in touch with infective environments or because they carry the infection and bring it to hitherto unexposed destination (Aagaard-Hansen, *et al.*, 2010).

Kloos et al. (2009), in their review of the prevalence factors of schistosomiasis, noticed that the largely higher schistosomiasis rates among poorer Brazilians; a great percentage of whom, particularly older adults, are uneducated has deep consequences for schistosomiasis management. The inability of people to read the health promotion literature and convert this information into preventive conduct has hampered schistosomiasis control. The failure of health personnel to inform, encourage, train and inspire communities and their leaders to take a central position in improving their health has undermined the five definite aims of health education in schistosomiasis management using the primary health care approach, that is to prevent and regulate transmission through alterations in water contact behaviour, to enhance environmental cleanliness through the control of fecal and urinary contamination of snails environments, to act in accordance with chemotherapy, to assist and collaborate with snail regulation programs, and finally, to encourage health-promoting behaviour and community drive to sustain these programs, together with growing self-reliance in health activities (Kloos et al. 2009).

## **2.9 Health-Seeking Behaviour for Schistosomiasis-Related Symptoms**

Health-seeking behaviour is used to refer to when individuals strive for medical assistance and whom they turn to in the beginning for help (Brown & Barrett, 2010,). The North American Nursing Diagnosis Association has also defined health-seeking behaviour as a state in which an individual in stable health is vigorously in search of ways to modify personal conducts or setting in order to move toward a greater level of health. In simple terms, therefore, health seeking behaviour can be perceived as any act embarked on by people who identify themselves to have a health challenge to discover a suitable solution.

In a study on accessibility to and utilisation of schistosomiasis, dos Reis et al. (2010), related health services in a rural area of state of Minas Gerais, Brazil, indicated that in a 2007 survey about symptoms and actions taken, symptoms observed to be schistosomiasis-related during the 30 days prior to the 2007 survey were reported by 15.4% of the survey respondents in the central village and by 18.1% of those in the rural region. Exactly, 57.2% reported diarrhea, 27.7% reported stool blood and 12.8% reported abdominal pain. Nonetheless, of all the infected people, only 11.8% search for care for those symptoms at a health facility and most people in both areas used traditional medicines. In the central village, more study participants took part in community groups than in the rural zone and used home remedies such as medicinal plants to treat diarrhoea, blood in the stool and abdominal pain.

According to Danso-Appiah *et al.* (2010), the percentage of patients who reported to be willing to take more than half a day in staying at health facility in search for treatment is much lower in the northern part of Ghana than in other regions. People after noticing symptoms undertook self-medication and later visited a health facility as a second or third alternative. The propensity to seek health care was lowest for the symptoms with severer characteristics such as blood in urine, painful urination, swollen abdomen, but when these patients do something, they will more probably to go to the health facility. The most frequently mentioned reason people did not visit the health facility for their symptoms, were a lack of money and symptom not serious enough.

Danso-Appiah *et al.* (*Opcit*) further noted that socio-economic status, age, someone else paying for health care, provided some effect but no obvious pattern. Sex, length of symptom, observed quality of health centre and time for visiting health facility did not

show a substantial effect. Typically, symptoms more often led to action for young children (aged 0–9) than for teenagers and to a reduced extent for grown-ups. Although this impact was commonly not substantial, the direction was fairly steady. Similarly, Danso-Appiah *et al.* (*Opcit*), noted that the propensity to take action for symptoms is greater for high socio-economic position or if someone other than the respondent provided money for health treatment. The impact of locality is less obvious, though individuals in the central region were less motivated to seek health care than in the south, and to a slighter extent north.

Among rural Zimbabwean women, Kallestrup *et al.*, (2005) have shown that late treatment for genital schistosomiasis is a high risk element for HIV-1 infection, mostly among females due to the destruction of the genital mucosa connected with persistent haematuria. Due to socio-cultural considerations such as gender, sexuality, power relations, poverty, educational level and cultural practice and norms, women do not discuss sex in some societies (Boivin *et al.*, 2007). This obviously affects their health seeking conduct. Because schistosomiasis is not considered a severe disease since it is seen as a sign of male menstruation. However, in other societies, male victims are ostracized; because of that patients turn not to report or seek treatment for it (Ukwandu & Nmorsi, 2004).

## **2.10 Prevention and control of schistosomiasis**

In areas with a high disease burden, the endorsed approach for the control of schistosomiasis is morbidity control, made possible by the administration of drugs. The WHO recommends national control programs for schistosomiasis to mostly target children of school going age and other high-risk clusters. Of late, the WHO has predicted

that preschool-age children may be at a similar risk of schistosome infection and morbidity as their school-age relations, and that they should be as well targeted (WHO, 2013). The treatment of schistosomiasis has experienced major advances in chemotherapy than many parasitic diseases. The introduction and extensive use of the current highly effective anti-schistosomal drugs have provided people tasked with the management of the disease opportunities (Alika, 2013). The chief object of chemotherapy is the treatment of infected people by the eradication of the infection. The disadvantage with chemotherapy, however is that it fails to tackle the origins of infection and reinfection of schistosomiasis. For this reason, better water supply and hygiene, coupled with health education, are the crucial approaches to reach viable decreases of these parasite infections (Apuusi, 2012).

### **2.11 Elimination of Schistosomiasis**

According to WHO (2007), attaining and sustaining control of schistosomiasis and probably accomplishing local eradication are the year 2020 targets set by the WHO. When migrating from control to eradication, vigorous observation and recognition of progressively low-transmission zones is necessary, but proven very problematic. Currently, it is progressively being acknowledged that malaria transmission becomes more and more focal as malaria prevalence are reduced (Meurs, 2014). As related phenomena may take place in a post-control situation for schistosomiasis, approaches need to be established with a suitably high geospatial resolution to detect even the tiniest schistosomiasis hotspots. Because it will not be cost-effective to regularly gather parasitological data from human inhabitants in a post-control environment, new ways of noticing schistosomiasis should be developed perhaps through environmental sampling. Moreover, it is likely that Mass Drug Administration alone cannot break the Schistosoma

life cycle and that complementary interventions will have to be developed for schistosomiasis eradication, such as the delivery of clean water and better sanitation, snail control, and behaviour change (Freeman *et al.*, 2013, cited in Meurs, 2014). On the contrary, Apuusi (2012) maintained that, improved water supply and sanitation with health education, are the essential approaches to reach viable decreases of these parasite infections. They are also consistent with the findings of Steinmann *et al.* (2006) that improvements in water supply and hygiene can disruption the cycle of transmission through diminished human-water contact and reduced environmental pollution with excreta.

## **2.12 Conceptual Framework**

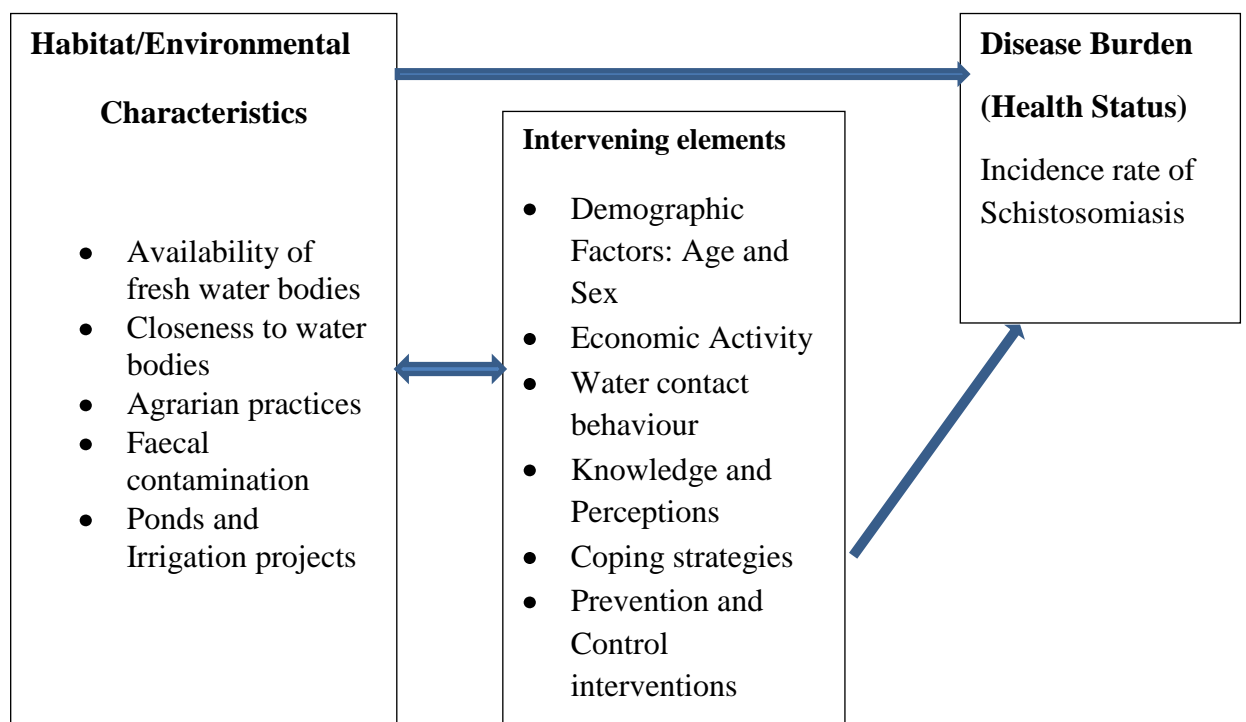
In order to explain the prevalence of schistosomiasis, the study combined ideas from Meade's (1988) triangle of human ecology model and a model propounded by Larbi (2013). According to Meade *et al.*, disease prevalence is affected by interaction of three variables, namely habitat, population, and behaviour. Habitat as explained or noted by Meade *et al.* (1988) is the aspect of the environment within which people live and thus directly affects them. The aspects or components of the environment include houses and workplace, physically and naturally occurring biotic and abiotic phenomena, health care services, transportation system as well as government. The population segment focuses on the human organism as the potential host of the disease. The ability of the population to cope with the various aspects of maladjustment is a function of genetic susceptibility or resistance, its nutritional status, and its immediate physiological status. Behaviour is regarded as the observable aspect of culture. It stems from cultural precepts, economic constraints, social norms and the individual as well as mobility, roles, cultural practices and technological innovations. Through the behaviour, people create habitat conditions,

expose themselves to or protect themselves from habitat conditions and thus move elements of the habitat from place to place. Relying partly on this earlier model, Larbi (2013) provided a conceptual framework which is directly adopted for the study. His framework (Figure. 2.2) shows how environmental and demographic factors influence disease transmission and in particular schistosomiasis disease burden. The explanatory variables for the analysis at the community level include availability of fresh water, closeness to water bodies, ponds and irrigations projects, faecal contamination and agrarian practices. Also, demographic factors including age and sex, type of economic activity, the water contact behaviour, knowledge and perceptions as well as the coping strategies which serve as intervening factors between the environmental factors and schistosomiasis incidence will be inquired in the research. The pathways along which environmental factors influence the incidence of schistosomiasis will be discussed extensively.

Specifically, the creation of dam reservoirs and the execution of irrigation schemes frequently lead to an extension of the habitats of intermediate host snails, and hence new prospective transmission sites for schistosomiasis (Steinmann et al., 2006). Engagement in domestic and social activities in rivers and water bodies provide living quarters for the snails of the disease (Gomes et al., 2012). The communities are known for farming and fishing, which have been recognized as occupations with higher risks of schistosomiasis infection. The location of the community relative to a water body will be useful in determining the effect of water bodies on the cases of schistosomiasis in the study area. The spread of schistosomiasis is reliant on the dumping of human excreta in water bodies. Through this mechanism the eggs of the schistosomes pass from the urine or stool to continue the life cycle in a water body given the availability of the right snail

host (Carter Centre, 2010). This would perpetuate the life cycle of the schistosomes and hence escalate the risk of getting infected.

The intervening elements between the environmental features and the schistosomiasis disease burden consist of rate of contact with the source of infection, disease prevention and control interventions as well as knowledge and perceptions. The knowledge of the manner of transmission and the symptoms, the coping strategies and the perceptions about schistosomiasis will be inquired in the study.



**Figure 2.2: Influence of Environmental and Demographic Factors on Schistosomiasis Disease Burden**

Source: Adapted: Larbi, 2013

## **CHAPTER THREE**

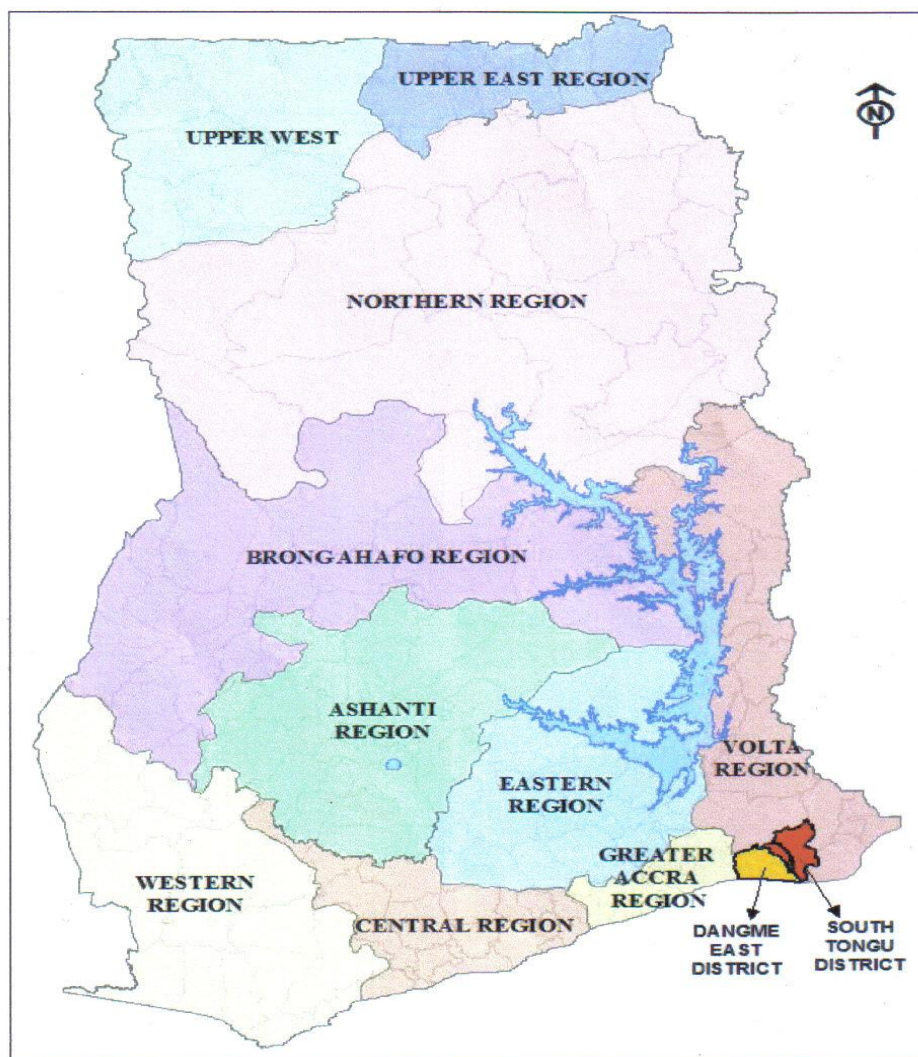
### **RESEARCH METHODOLOGY**

#### **3.1 Introduction**

This chapter is divided into two major parts, namely the study area and the research methodology. The study area section focuses on the description of the physical environment (habitat) and the socio-cultural and economic characteristics of the study communities. Essentially, this section provides a context for understanding the activities and attitudes of the populace that predisposes them to the risk of schistosomiasis infection. The methodology section, on the other hand, discusses the procedures adopted to undertake the research. Specifically, this section presents the research design and the methods of data collection and analysis.

#### **3.2 The Choice of Study Areas**

As noted in chapter one, this study focused on two districts, namely the South Tongu and the Dangme East. The main factors (variables) considered in the choice of these districts include, location, the environment (habitat), population characteristics; and socio-cultural and economic activities of the populace. In terms of location and environment, these two districts are very close to the Volta Lake and are located within regions that promote the host snail disease vector (see Figure 3.1). Majority of the population in both districts are involved in fishing and farming, which tend to expose them to the risks and hazards of schistosomiasis infection.



**Figure 3.1: Map of Ghana showing the study areas in Yellow and deep Brown colours; Dangme East and South Tongu respectively.**

Source: CERGIS, University of Ghana, 2011

### **3.2.1. Characteristics of the Dangme East District**

#### ***3.2.1.1: Location and Drainage***

The Dangme East District is located in the Eastern part of the Greater Accra Region between Latitudes  $4.44^{\circ}$  and latitude  $5^{\circ}$ N (see figure 1). It shares common boundaries with North Tongu District on the North, South Tongu District and Dangme West District

on the East and West respectively. At the south is the Gulf of Guinea, which stretches over 45 km (27.9 miles). The District covers a total land area of about 909 sq. km (350 sq. miles), which is about 28% of the total area of the Greater Accra Region (Acheampong, 2011). Ada Foah, the district capital, is located at the south-eastern part, about 20km off the Accra-Aflao road, along the coast and about 2km from the Volta River Estuary. Other major settlements in this district are Big Ada, Kasseh, Goi, Anyamam, Lolonya, Akplabanya, Wokumagbe, Koluedor and Sege.

The District forms part of the central portion of the Accra plains, depicting a topography that is generally gently undulating. A few prominent highlands (inselbergs) are scattered irregularly over the area, with the highest part being about 240 metres (800ft) above sea level. The rest of the area is about 60 metres (200ft) above sea level (Acheampong, 2013).

The major river in the District is the Volta River, and it runs along the south-east section forming part of the eastern boundary and entering the sea southwards. Other major water bodies are the Futue River, Sege River, Akplaba, Luhue, Kajah and the Songor lagoon. There are also several streams and rivulets.

Most of these streams are seasonal and dry up during the dry season. The result has been the creation of dugouts and ponds of varying sizes for the purpose of irrigation, domestic use and rearing of livestock. This borders the southern portion of the district and feeds or drains into the major lagoons during high or low tide periods. Despite its numerous economic and social values, the sea also increases the salinity of water into dugouts and wells close to it, thus making water from such sources unwholesome for domestic use.

### **3.2.1.2: Climate and Vegetation**

The District forms part of the south-eastern coast plains of Ghana which is one of the hottest parts of the country. Temperatures are high throughout the year and range between 23<sup>0</sup>C – 28<sup>0</sup>C, a maximum of 33<sup>0</sup>C is attainable during the hot season. Rainfalls are heavier during the major season between March and September. The average rainfall is about 750mm; the area is very dry during the Harmattan season when there is no rainfall at all. Humidity is very high, about 60% due to the proximity of the sea, the Volta River and other water bodies. Daily evaporation rates range from 5.4mm to 6.8mm (Dickson & Benneh, 1980).

The vegetation is basically coastal savannah, characterized by short savannah grass interspersed with shrubs and short trees; along the coast, stretches of coconut trees could be seen. A few strands of the mangrove trees can also be found around the Songor lagoon and the tributaries of the Volta River where the soil is waterlogged and salty (Dickson & Benneh, 1980). This type of vegetation is also common along the fringes of some of the islands in the Volta River. The mangrove trees which grow to heights of up to 15m are dense and green in appearance throughout the year. The mangrove vegetation is cut down for its wood which serves as domestic fuel. The northern part of the district has a forest (woodland) type of vegetation which is a mixture of trees and grass with the major trees being the Nim tree. The savannah aspects of the grassland provide extensive land for grazing livestock.

### **3.2.1.3: Economic Activities, Services and Health Care Services**

As in many communities in the Accra plains of Ghana, nearly 60% of the active population is engaged in agricultural related activities. Majority of the male farmers are

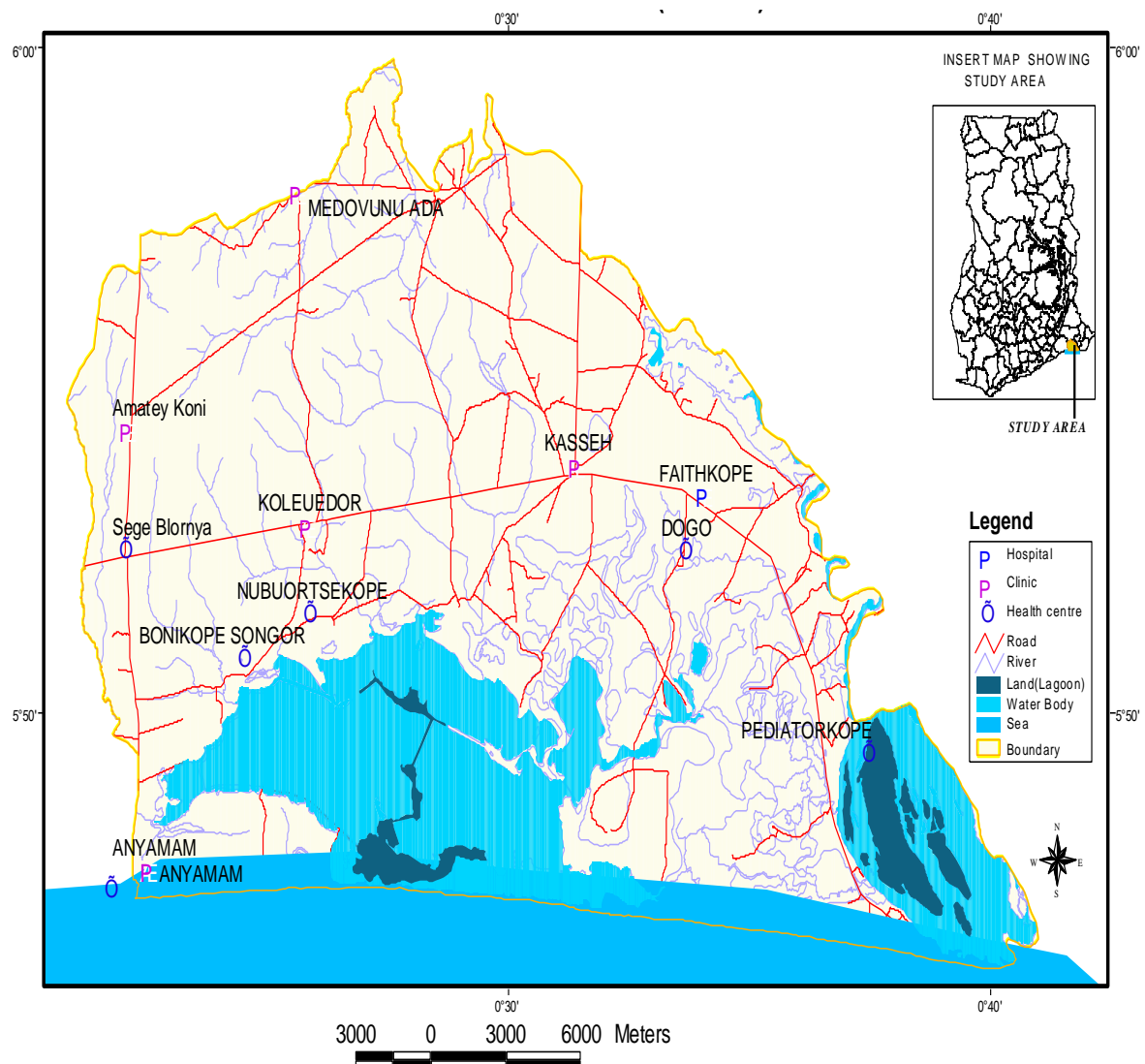
involved in crop production and fishing. Women are also involved in fish smoking and trading. The Dangme East District has about eighty per cent (80%) coverage of good portable water supply to various communities across the district. This positive development is due to the fact that the district had the support of donor partners such as Department for International Development (DFID), Danish International Development Agency (DANIDA) and the Government of Ghana (GOG) through the extension of water supply from Keseve and Aveyime Head Pump Stations to the district. However, about twenty-seven (27) lands, otherwise describe as islands or overbank communities are yet to have their fair share of potable water for use due to the difficulty in laying pipelines across the Volta River. These communities, nevertheless, include the study villages for this research. The District Assembly, however, is seeking possible donor support to extend portable water across the river to affected communities.

With sanitation, the situation is very discouraging with only forty-eight per cent (48%) coverage which is highly insignificant. Even with this achievement, the coverage is limited mostly to Institutional Toilets such as KVIP's and a few water closet facilities. The private sanitation, that is, household toilets are virtually insignificant. This situation, the assembly attributed among others:

- to lack of counter funding to support the project.
- to less funds allocated to the sector for project implementation.
- due to the priority given to education at the expense of other sectors in the annual planning of the assembly.

There are a number of health facilities including one district hospital at Faithkope which caters for major health problems transferred from the other clinics and health posts variously dotted in the district. The principal towns of Sege, Kasseh, Pediatorakorpe and

Ada-Foah are credited with sub-district clinic each (see figure 3.2). Additionally, there are communities designated as Community Health Planning Services (CHPS) Zones. These places include Pute, Dogo, Madavunu and Adedetsekorpe. The health services provided by these facilities designated (CHPS) Zones are limited to preventive, curative, family planning and health education, home visitation and immunization services. However, each of the Community Based Health Planning and Service (CHPS) facility either provides one or two or more of the aforementioned services.



**Figure 3.2: The Sub-District Map Health Map of the Dangme East District**

Source: Dangme East District Health Directorate, 2011.

### **3.2.2. Characteristics of South Tongu District**

#### ***3.2.2.1: Location and Drainage***

The South Tongu District which was carved out of the Tongu District is one of the Eighteen Districts in the Volta Region with a population of 72,333 people (Ghana Statistical Service). The District is located in the Southern part of the Volta Region and bounded to the north by the North Tongu District, to the East by the Akatsi and Ketu Districts to the West by Dangme East District of the Greater Accra Region and to the South by the Gulf of Guinea. The District has a total land area of 594.75 square km. The general relief of the area is 75m above sea level on the average. There are five traditional areas in the District namely: Agave, Fievie, Sokpoe, Tefle and Vume and the largest is Agave Traditional Area.

The River Volta, one of the biggest natural resources which drain the district, provides the impetus for the fishing industry and irrigated agriculture. Other natural resources that exist in the Districts which could be developed or tapped include the clay deposits at Lolito, Vume and Sokpoe areas; sand deposits at Dabala, Sokpoe, Agordomi and Agortaga, gravel at Todze and salt at Gamenu.

#### **3.2.2.2: Climate and Vegetation**

The climate of the District lies within the wet semi equatorial and dry equatorial climate zones. The northern part lies within the wet semi equatorial zone while the southern part is in the dry equatorial climate zone. The climate of the District is also influenced by the southwest monsoon winds twice a year, resulting in a double maxima rainfall regime. Temperatures range between 22.6<sup>0</sup>C – 29.3<sup>0</sup> daily, thus giving a relatively small diurnal range of temperature. Average annual rainfall is about 195mm with a double maxima

regime. The major rainfall season is between March and July, with the minor season occurring between September and mid-November. Humidity is between 60% and 65% while daily evaporation rates range from 5.4mm to 6.8mm (Dickson & Benneh, 1980).

The vegetation of the District is located within the coastal Savannah Zone. The southern section is covered with swamps and mangroves, while the northern section is predominantly savannah woodland. The savannah vegetation supports livestock production, this has situated the district among the largest livestock producing districts in the country. Children are unfortunately used in lives stock herding as a means of cheap labour.

### **3.2.2.3: Economic Activities and Health Care Services**

About 60% of the active population is engaged in agricultural related activities. The economic activities of the people are in the areas of crop and livestock production and extensive inland fishing practices due to free access to the Volta River. Communities such as Alikekofe and Agave, Afedume and Tadze are respectively and particularly noted for their shrimp and clam harvesting. These economic activities alongside Tilapia fishing and animal husbandry are practical in most cases without entering the Volta River.

The population of the area shows an increasing trend. In 1984, the population was 53,252 and this increased to 72,333 in 2009 (Ghana Statistical Services, 2010). The population is relatively young with 40% being under 15years of age. The district is experiencing out-migration of active population due to ecological changes that resulted from the

construction of the Akosombo and Kpong dams which have made the areas less productive in terms of fishing, cultivation and livestock production.

The District has 84 public primary schools with a total of 12,748 children and 12 private schools with a total of 1,139 children, 44 public Junior High Schools (JHS) with a total of 3,107 students, 2 private JHS with the a total of 30 students, 3 senior high schools with a total of 2,588 students and a Technical institution. Until recently, water supply in the district was non-existent and it is still inadequate for most parts except for Ada-Foah which has access to pipe-borne water provided with the support of DFID. DANIDA had attempted on numerous occasions with no success at drilling boreholes, either because the water table was either saline or just dry. Most schools, therefore, do not have access to quality water for the children. DANIDA has also provided KVIPs to the District, but these are inadequate. Toilet facilities as well as waste disposal facilities at schools are also woefully inadequate.

With regards to the South Tongu District, the provision of good water and sanitation is not all that different from the Dangme East District. In totality, the district has about sixty-six point seventy-eight per cent (66.78%) coverage of good potable water supply to various communities across the district. The potable water supply facilities in the South Tongu District include Bore-Holes totaling fourteen (14), Pipe borne Schemes totaling thirty-three (33) and Ferrow Cement Tanks also totaling twelve (12) are variously dotted across the area. This positive development is due to the fact that the district had the support of donor partners such as Department for International Development (DFID), Danish International Development Agency (DANIDA), European Union (EU) Millennium Development Agency (MIDA), German Embassy, Community Based Rural

Development Programme (CBRDP), Quality Grain, Roman Catholic Mission, Church of Christ, HIPIC and the Government of Ghana (GOG) through the extension of water supply from Keseve and Agordome Head Pump Stations to the district.

With regards to sanitation in the South Tongu District the picture is not very impressive with only forty-three per cent (43%) coverage which is equally insignificant. However, with this development, the district has a coverage of eighty-four (84) Institutional KVIP latrines, four hundred and twelve (412) household latrines and a further twenty (20) and seven (7) household latrines built by the Adventist Development and Relief Agency (ADRA), Ghana and the Roman Catholic Mission (RCM) respectively. The inability of the households in the district to construct KVIP in their homes, according to the assembly is attributed to under listed reasons the unwillingness of families to construct KVIP in their homes. Also thick compact clay of the land is not good for latrine construction.

The South Tongu District has a number of health facilities including one major district public hospital, that is the South Tongu District Hospital at Sogakope and another major private mission hospital, known as the Comboni Mission Hospital also located at Sogakope. In addition to the two main hospitals, the district is also credited with Community Based Health Planning and Service (CHPS) Zones. These health facilities are variously dotted in the district at vantage locations which include Dordoekepe, Sotewu, Sogakope, Dabala-Adutor, Agota-Gamenu, Agbakope, Agordomi, Larve and Dorkploame. The health services provided by these facilities designated (CHPS) Zones are limited to preventive, curative, family planning and health education, home visitation and immunization services. However, each of the Community Based Health Planning

and Service (CHPS) facility either provides one or two or more of the aforementioned services.

### **3.3. Methodology**

#### **3.3.1. Research Design**

Given the broad nature of this study, a mixed-method design was employed. In the view of Tashakkori & Teddlie (2010), such a triangulation of methods was also deemed appropriate in view of the inherent limitations of dichotomous qualitative and quantitative approaches. The qualitative strategy, which entails the use of words and narratives, is often said to be very effective for detailed explanations on behaviours and experiences (Bryman, 2001; Winchester, 2005). However, this approach is not really effective in establishing patterns and relationships among variables (Bryman, 2001). On the other hand, the quantitative strategy, which involves the use of statistical techniques in analysing data, allows for generalization and predications. However, this approach is not very useful for in-depth explanation of behaviours and experiences (Tashakkori & Teddlie, 2010). It is, therefore, as a result of the above strengths and weaknesses of these dichotomous approaches that this researcher decided to use methods triangulation.

One component of the quantitative analysis involved the analysis of secondary data (from hospital records and directorates of health services). This analysis helped to understand the temporal and spatial dimensions of disease prevalence. Additionally, a questionnaire survey was used to gather quantifiable data from the people living in the study communities. On the other hand, in-depth interviews were used to generate data for the qualitative analysis.

The combination of quantitative and qualitative methods enabled the researcher to expand the breadth of the study as well as enhance validity of findings (Bryman, 2001). The quantitative methods also compensated for the weaknesses of the qualitative methods. In fact, while the quantitative methods were useful for generalizations and the establishment of relationships between different variables (e.g. relationship between gender and incidence of the disease) (Castro *et al.* 2010), they were not effective for explaining experiences and behaviour of research participants. On the other hand, although qualitative method was inappropriate for generalizations (Plano Clark *et al.*, 2008), it was more flexible and effective for getting a deeper understanding of specific issues (for instance, while incidence of the disease was higher among men than women) (Winchester, 2005; Castro *et al.*, 2010). In this way, methodological triangulation helped the researcher to enhance validity of findings. In the presentation that follows, the specific data collection methods are discussed.

### **3.3.2 Research Instruments used**

The researcher used two survey instruments to seek for information from the respondents concerning the incidence of schistosomiasis. Questionnaire and personal interviews were used to solicit data from respondents. The questionnaire was to solicit data from health officials concerning the rate at which victims access their facilities for treatment.

The Wikipedia encyclopedia explains a questionnaire as a research instrument that consists of series of questions and other prompts for the purpose of gathering information from respondents. (“Questionnaire”, Wikimedia Foundation, Inc). It is a method of collecting a broad range of information from a large number of respondents.

The researcher constructed and administered copies of questionnaire to a large number of respondents from the research catchment area. Questions were frequently reviewed with the supervisor and research experts and all points discussed together to correct errors.

Interview is a purposeful conversation in which one person (interviewer) asks prepared questions and another (interviewee) answers them (Frey & Oishi, 1995). It is also an oral questionnaire in which respondents give needed information verbally in a face-to-face deliberation (Best, 1981). Respondents' thoughts and explanations are usually recorded or written while giving information to the interviewer to allow him or her not to lose any essential data.

Interviews are usually characterized by open-ended questions which give respondents the desire to express their thoughts, knowledge and opinions in their own words. It is useful as a follow-up to responses to a questionnaire. It is also necessary for unravelling complex topics. In administering an interview, it is very necessary to consider the tone, sequence and wording of questions. This helps to produce a higher rate of relevant responses.

In this research, the researcher arranged and conducted several interviews with indigenes and riparian communities as well as health officials. Samples of the questionnaire and interview guide used for the study can be seen in the appendix

### **3.3.2.1 Questionnaire Survey**

A questionnaire survey was used to collect data from a sample of respondents from the two districts. A survey design involves collecting data to test the hypothesis or answer research questions concerning the current status of the subject or phenomena

(Winchester, 2005). It thus seeks to find answers to questions through analysis of relationships between or among variables (Castro *et al.* 2010). Survey deals with facts, attitudes or perceptions. It also provides a methodical and systematic account, accurate and precise description of issues, events, and phenomena. Data, thus gathered through survey represents accurate field conditions and it answers questions analytically and interpreting situations, phenomena and events as they are presented (Bryman, 2001).

On the other hand, some limitations of survey design have been noted in the literature. Plano Clark *et al.*,(2008) is of the view that the survey design restricts experience in two ways. Firstly, by directing research to what is perceived by the senses. Secondly, it employs only standardized tools based on quantifiable data to test hypothesis. He further noted that the survey design cannot capture the real meaning of social behaviour. Quantification as noted often results in “meaning” that are closer to the beliefs of the researcher than those of the respondents. The author further explained that though survey covers a wide scope and spectrum of responses, the data generated may lack much in terms of detail or depth of the problem investigated. Despite these weaknesses of the survey design, it was adopted for this present study because the survey is the best method of collecting quantifiable data to describe patterns of disease prevalence and also perceptions about the disease.

The questionnaire used for this study was made up of both close and open ended questions. In order to ensure that the respondents really understood the questions and also to enhance the response rate, the administration of the questionnaires were done by the researcher and the research assistants. The questions were generally read out to the respondents. Respondents who could read and understand were allowed to complete the

questionnaire on their own; but in the presence of either the researcher or the research assistants. In situations, where these respondents had problems understanding some of the questions, they were assisted.

### **3.3.2.2 Pilot Study: Pre-testing of questionnaire**

The researcher carried out reconnaissance visits to the study villages during the inter-semester breaks between 2009 and 2010 to find out the status of schistosomiasis incidence in the study districts to see how the disease was affecting the people in terms of their economic activities. This assisted the researcher greatly in shaping the needed impressions about the study areas and to give guidance in the crafting and formulation of the questionnaire and interview items as well as earmarking phenomena to be observed. The pilot (pre-testing of questionnaire) study was conducted in the Dangme West district that shares borders with the Dangme East. The purpose of the pilot study was to ascertain the validity and reliability of the instrument (Cronbach (1957)). The Dangme West was selected because it possesses similar environmental characteristics with the two study areas also located in the lower Volta basin with numerous streams and rivulets that provide conducive conditions for thriving and survival of the schistosomiasis host snails. The inhabitants also engage in similar economic activities of fishing, farming, and trading in fish and clams. A total of 20 questionnaires were administered by the researcher.

### **3.3.2.2 Population**

The total target population for the study was 373,720 comprising 299, 048 and 79, 720 for Dangme East and South Tongu respectively. The criteria for the inclusion of a unit in a survey are based on the characteristics of the respondents who are legible for participation in a survey. For the purpose of this study, the legible target population of

373,768 is the combined population for the two areas, the Dangme East and South Tongu districts. The accessible and vulnerable population from which the sample was extracted is the very active part of the population that is daily and constantly in contacts with the infested water bodies through their daily activities and water usage. The vulnerable population of 1658 is located in the relatively deprived and rural areas of two districts specifically in the following areas and locations:

- the overseas islands include Pediatorkope, Alorkpem (Dangme East); Agave, Alikekope (South Tongu)
- dwellers within the immediate vicinities of water bodies which are constantly used for laundry, watering of crops, fishing and clam harvesting as well as drinking water for livestock.

The vulnerable population virtually depends on the existing water bodies for their daily activities. These rural locations have virtually no pipe borne water facilities. Similarly, there are no existing sanitation facilities. All these factors make them vulnerable to schistosomiasis infection.

### **3.3.2.3 Sample and Sampling Procedure for Questionnaire Survey**

Pollit & Hungler (1999) extensively elaborated on a sample size and its composition by indicating that there are certain non-definitive practices that are adopted by social research practitioners that are worth noting for adoption and application in this study. They noted that if the population is only a few hundreds, then a 40% or more sample size will be appropriate and therefore satisfactory, but if it is in many hundreds, then 20% will suffice.

A sample size of 320 respondents made up of 160 respondents from each of the two study districts was used for the study. The sample size was based on the ranges of 5% or

less from several hundreds suggested by Clark *et al.*,(2008) and the minimum sample sizes provided by Frankel and Wallen, (2002). The accessible population of 1658 was stratified into three horizontal strata based on location with reference to the islands and nearness to the main water bodies. These Strata are the:

- islands (overseas islands)
- immediate vicinity areas of the Volta river and other water bodies

People in distant areas from the water population were further structured into adult females, adult males and children (school children) with a numerical representation as shown in Table 3.1a.

**Table 3.1a: Accessible population**

<b>Category of persons</b>	<b>Number</b>
Adult Females	726
Adult Males	658
Children	274
<b>Total</b>	<b>1, 658</b>

The sample for the study was purposefully selected. It was composed proportionally, through simple randomization based on a 5% representation of the age categories with reference to the accessible population. Each district was fairly represented. Table 3.1b shows the samples for the various categories.

**Table 3.1b: Sample population**

<b>Category of persons</b>	<b>Number of respondents</b>	<b>Percentage</b>
Adult Females	166	43.8
Adult Males	122	39.7
Children	32	16.5
<b>Total</b>	<b>320</b>	<b>100</b>

Thus included in the accessible study population are adult women engaged in related inland fishing activities during the sampling time-frame, adult men, involved in inland fishing as well as school children living in the study communities and constantly come into contact with the infected water bodies. Also included in the study are key personalities of the medical services in the study areas (they are mainly located in far away from the rivers by staying in the urban areas).

### **3.3.3. Interviews**

The interviews were used to collect data from different categories of respondents. First, key informant interviews were conducted with two officials in each of the district health directorates. One official in each of the district assemblies and 3 public health nurses from each district were also interviewed on measures that they were taking to control the disease in their respective districts. Additionally, one to one interview encounters were used to elicit further and supplementary information from 13 respondents especially on clarification of issues that could not be explicitly expressed and captured from the questionnaire survey. These respondents were selected purposively on the basis of interest in their questionnaire responses. Since the key informants have different backgrounds, different interview guides were used for each group. The interview guides for community research participants were also flexible as they just contained a list of relevant topics to be discussed. The

### **3.3.4 Data Analysis Procedure**

The study was a descriptive survey study and the main statistical tool employed to analyse data was the Statistical Package for the Social Sciences (SPSS). The SPSS offers a comprehensive range of contemporary descriptive statistical methods. It also has a good editing and labelling to produce output in both reports and table formats. It also has

the ability to handle missing data effectively. Percentage tables and graphical charts were used for analysis. The percentage tables facilitated comparison of results and the graphs and charts provided assisted visual impression of the analysis and discussions. The study used Spearman's rank correlation and Pearson's Chi-Square to check the co-efficient of the incidence of the disease in relation to their age, sex and level of education of the sample population.

The qualitative data, on the other hand was subjected to intensive content analysis. The statistical inferential analysis was carried out based on responses and other environmental concepts under study. The study also used GIS for spatio-temporal analysis of the data. According to Yan (2013), it is advantageous to use GIS because it is mostly appropriate for providing pictorial, spatial-temporal charts for disease patterns, helping to identify high risk localities and periods of disease. The most significant and potent function of GIS is the spatial analysis. GIS is a supportive tool that can be used to offer an improved understanding of the spatial disparities of diseases and their connection to socio-environmental elements and the health care system.

## CHAPTER FOUR

### BACKGROUND CHARACTERISTICS OF RESPONDENTS AND SPATIO-TEMPORAL ANALYSIS OF SCHISTOSOMIASIS CASES IN THE DANGME EAST AND SOUTH TONGU DISTRICTS

#### 4.1 Introduction

It is generally acknowledged that the prevalence of many diseases of man, including schistosomiasis, may vary spatially and temporary due to differences in environmental and anthropogenic factors (Bosompem, 2004). An understanding of the spatial dynamics of any disease is very important for its management (Kogulan & Lucey, 2007). The main aim of this chapter is to provide a spatio-temporal analysis of schistosomiasis in the two districts. The chapter, however, starts with a brief presentation of the distribution of survey respondents according to specific background characteristics, namely gender, age, and occupation, among others. These characteristics are important for the subsequent analysis because they constitute integral part of the ‘population’ and ‘behaviour’ aspects of the disease ecology model (Mead, 1988).

#### 4.2 Socio-Demographic Characteristics of Sample Population

It is generally acknowledged that socio-economic characteristics of a population influences their susceptibility to certain infections as well as their ability to cope with various disease conditions (Odei, 1983), including schistosomiasis (Collier *et al.*, 1998). In view of this, the researcher considers it very imperative to examine the distribution of respondents by specific demographic variables. This is based on the data collected in the two districts.

In the South Tongu District, data was collected from four villages namely, Dzitorkoe, Agave, Afiadenyigba and Vume. In the Dangme East District, data was collected from Aflive, Alorkpem, Kewunor and Pediatorkope. In all there were 320 respondents, comprising 160 women and 160 men.

#### **4.2.1. Background Characteristics of Sample Population**

The demographic characteristics of respondents are presented in Table 4.0. The results show that for both districts, majority of respondents were in the age group 35 years and below, as 78.5% respondents in the Dangme East District and 63% of respondents in the South Tongu District fell in this age group. About 52% of respondents in the Dangme East district and 48% of those in South Tongu district were females. Majority of respondents in both districts had some level of formal education but it was surprising that only few respondents had tertiary level of education. For Dangme East district, 82.5% of the respondents had JHS and SHS level of education and only 2.5% of them had tertiary level of education. Also for South Tongu district, 60% of the respondents had JHS and SHS level education and only 3.75% had tertiary level of education.

The results further show that majority of respondents in the South Tongu district had no formal education as compared to respondents in the Dangme East district as 36.25% of respondents in South Tongue had no formal education and only 15% of respondents in the Dangme East district had no formal education. The low level of education in the area is because the children are often engaged in economic activities such as fishing and farming.

The results further show that for both districts, the predominant occupation for respondents was fishing and farming. About 63.5% of respondents in the Dangme East district were either in fishing or farming while 70% of respondents in the South Tongu District were either engaged in fishing or farming. The reason for the dominance of these primary activities is the fact that as in many rural districts in Ghana, these areas lack manufacturing industries.

**Table 4.1a: Demographic characteristics – Age distribution**

<b>Age</b>	<b>Dangme East</b>	<b>South Tongu</b>
Less than 18	65(41%)	55(34.3%)
18-35	60(37.5%)	46(28.75%)
36-60	26(16.25%)	37(23%)
60 and over	9(5.625%)	22(13.75%)
<b>Total</b>	<b>160 (100%)</b>	<b>160 (100%)</b>

Table 4.2b: Demographic characteristics – Sex distribution

<b>Sex/Gender</b>	<b>Dangme East</b>	<b>South Tongu</b>
Male	77(48%)	83(52%)
Female	83(52%)	77(48%)
<b>Total</b>	<b>160(100%)</b>	<b>160(100%)</b>

Table 4.3c: Demographic characteristics – Educational level

<b>Educational level</b>	<b>Dangme East</b>	<b>South Tongu</b>
Tertiary	4(2.5%)	6(3.75%)
SHS/Vocational	50(31.25%)	38(23.75%)
JHS	82(51.25%)	58(36.25%)
No education	24(15%)	58(36.25%)
<b>Total</b>	<b>160</b>	<b>(100%)</b>

**Table 4.4d: Demographic characteristics – Occupation**

<b>Occupation</b>	<b>Dangme East</b>	<b>South Tongu</b>
Farming	65(41%)	46(28.75%)
Fishing	68(42.5%)	66(41.25%)
Trading	10(6.25%)	25(15.6%)
construction	17(10.6%)	23(14.4%)
<b>Total</b>	<b>160(100%)</b>	<b>160(100%)</b>

**Source: Field data, 2012**

### **4.3 Incidence of the schistosomiasis among survey respondents**

Given the poor nature of health records in developing countries, one of the methods of getting data on the prevalence of a disease is through social surveys (Ghana Statistical service, 2008). To find the prevalence of the disease in the study areas, the researcher asked questions about the frequency of infections in the two districts. This was done by interviewing the respondents in the affected communities. The researcher went ahead to examine the relationships between the experience of schistosomiasis and age, sex and educational level.

The prevalence of schistosomiasis in the Dangme East district and South Tongu district is presented in table 4.2. The results indicate that 51% of respondents in the Dangme East and 49% of their counterparts in South Tongu have ever experienced the schistosomiasis disease. The questionnaire survey from the two districts indicates that, there is not much difference in the reported incidence of the disease.

**Table 4.5: Respondents who ever experienced Schistosomiasis**

<b>Ever Experienced Schistosomiasis</b>	<b>Dangme East</b>	<b>South Tongu</b>	<b>Total</b>	<b>Percentage %</b>
<b>Yes</b>	103(51%)	98(49%)	201	62.8
<b>No</b>	57(48%)	62(52%)	119	37.2
<b>Total</b>	<b>160(100%)</b>	<b>160(100%)</b>	<b>320</b>	<b>100</b>

Source: Field Data, 2012.

Table 4.3 below shows the frequency of experience of the disease. The results indicate that majority (63%) of respondents had experienced the disease at least once, 15.9% experienced the disease twice and 21.1% experienced it three times or more. When the two districts are compared, people in South Tongu were more likely to be attacked three or more times than those at Dangme East (64% against 35.7%). This situation in the South Tongu District could be attributed to lack of intensive health education.

**Table 4.6: Frequency of Attack of Schistosomiasis**

<b>Frequency of Attack</b>	<b>Dangme East</b>	<b>South Tongu</b>	<b>Total</b>	<b>Percentage %</b>
<b>Once</b>	76(59.8%)	51(40.2%)	127(100%)	63
<b>Twice</b>	18(56.3%)	14(43.4%)	32(100%)	15.9
<b>Thrice or more</b>	15(35.7%)	27(64.3%)	42(100%)	21.1
<b>Total</b>	<b>109</b>	<b>92</b>	<b>201</b>	<b>100</b>

Source: Field Data, 2012

#### **4.3.1 The Relationship between Age and the Experience of Bilharzia**

The relationship between age and the prevalence of the disease under investigation has been quite well discussed in the literature. Some studies have shown that children are more prone to the disease. In one study, Aboagye and Edoh (2011) found that as high as 78% of those infected with the disease were between the ages 5 and 15 years. Similarly, Xue et al., (2011) reported a prevalence of 87.3% and 84.1% respectively among children in the age groups 8-11 and 12-14. In an attempt to explain the high prevalence rate of the disease among children, Aliko (2013) and Steinmann *et al.* (2006) noted that children are predominantly reservoirs of infection due to their indiscriminate excretory practices, particularly urination when swimming, and their unparalleled opportunities for water contact in hot climates.

The data gathered in this study (Table 4.3) shows that the proportion of people ever affected by the disease declines with increasing age, from 65% among respondents who were less than 18 years to 58% among those who were 60 or more years. The descriptive statistics, thus, show that younger people are somewhat more susceptible to the diseases. As will be shown later, this result is also consistent with the secondary data obtained from the district health directorate in the two districts which suggests that younger people experience the disease than older people. This is something to be concerned about because these are people in the formative ages of their lives and this infection could be very detrimental to their growth and development. The Pearson Chi-Square was used to test the relationship between age and the prevalence of bilharzia.

**Table 4.7: Age and the experience of Schistosomiasis**

Age	Ever suffered bilharzia		Total	Percentage
	Yes	No		
<b>Less than 18</b>	79(65%)	42(35%)	121(100%)	37.8
<b>18-35</b>	63(60%)	42(40%)	105 (100%)	32.8
<b>36-60</b>	39(62%)	24(38%)	63(100%)	19.7
<b>60 and over</b>	18(58%)	13(42%)	31(100%)	9.7
<b>Total</b>	<b>199</b>	<b>121</b>	<b>320</b>	<b>100</b>

Source: Field Data 2012.

**Table 4.8: Chi-Square Tests between Age and the experience of bilharzia**

	Value	df	Asymp. Sig. (2-sided)
<b>Pearson Chi-Square</b>	.935	3	.817
<b>Likelihood Ratio</b>	.936	3	.817
<b>Linear-by-Linear Association</b>	.579	1	.447
<b>N of Valid Cases</b>	320		

Source: Field Data 2012.

The chi-Square test, in Table 4.4, shows a Chi-Square value of 0.935 with a probability value of 0.817 at 5% significant level. Since the probability value of 0.817 is greater than the significant level of 0.05, it is concluded that even though there is some relationship between age and the experience of bilharzia, the relationship is statistically not significant. The study therefore accepts the null hypothesis that, there is no significant relationship between age and the experience of Schistosomiasis. This conclusion is

therefore not consistent with the findings of Alike (2013) and Steinmann *et al.* (2006) that children are more prone to the disease than older people.

#### **4.3.2 The Relationship between Gender and the Experience of Bilharzia**

Table 4.5 shows the relationship between sex and the experience of bilharzia. The results show that more males experienced the disease as compared to their female counterparts as 62.6% of males experienced the disease as against 37.3% of their female counterparts. The chi-Square test, in Table 4.6, with one degree of freedom, shows a Chi-Square value of 8.460 with a significant figure of 0.004 at 5% significant level. Since the probability value of 0.004 is less than the significant level of 0.05, it is concluded that there exist is a relationship between sex and the experience of bilharzia and the relationship is statistically significant. The implication of this is that gender matters when it comes to the experience of bilharzia and that more males are affected with bilharzia than their female counterparts. This finding is in agreement with the information obtained from the district health directorate of the two districts which indicates that in all the health centres in both districts under study, males were more likely to present schistosomiasis cases than females. This can be explained within the context of the conceptual framework. Men tend to engage in domestic and economic activities in rivers and water bodies provide living quarters for the snails of the disease. The communities are known for farming and fishing, which have been recognized as occupations with higher risks of schistosomiasis infection. The involvement of men in farming and fishing escalate the risk of getting infected than their female counterparts.

This result of the study supports the findings by Nsowah-Nuamah *et al.* (2001) who found a significant relationship between sex and the incidence of the disease. A similar

observation was also by Kloos et al. (2009) in Brazil where it was indicated that fishing and other agricultural activities undertaken by men were significantly correlated with *S. mansoni* incidence and intensity of infection in most rural populations. The results of the study is however contradicted by a study conducted by Mafiana *et al.*, (2003) who found no significant difference in the infection rate between males and females.

**Table 4.9: Sex and the experience of bilharzia**

<b>Sex</b>	<b>Ever experienced disease</b>	<b>Never experienced disease</b>	<b>Total</b>	<b>Percentage</b>
<b>Male</b>	109 (62.6%)	65 (37.3%)	174(100%)	64.4
<b>Female</b>	90 (61%)	56 (39%)	146(100%)	45.6
<b>Total</b>			<b>320</b>	

Source: Field Data, 2012.

**Table 4.10: Chi-Square Tests between Sex and the experience of bilharzia**

	<b>Value</b>	<b>df</b>	<b>Asymp. Sig. (2-sided)</b>
<b>Pearson Chi-Square</b>	8.460	1	.004
<b>Likelihood Ratio</b>	7.803	1	.005
<b>Linear-by-Linear Association</b>	8.523	1	.004
<b>N of Valid Cases</b>	320		

Source: Field Data 2012.

### 4.3.3. The Relationship between Educational Level and the Experience of Bilharzia

The relationship between educational level and the experience of bilharzia is presented in Table 4.8. The results indicate that the proportion of sample who have ever experienced the disease was highest (45%) among those with JHS and lowest (6%) among those with tertiary education. Therefore, it appears that having tertiary education lowers ones susceptibility to attack by this disease. This may be explained by the fact that people with tertiary education are not likely to work as farmers or fishermen and as such their susceptibility to the disease is lower. A chi square test (see Table 4.9) however, shows that there is no significant relationship between educational level and the experience of the disease ( $X^2 = 4.510$ ,  $P = 0.211 > 0.05$ ). The study therefore accepts the null hypothesis and concludes that there is no significant relationship between educational level and the experience of the disease. One reason for this may be the fact that there are no significant variations in the educational levels of respondents. Majority of the people were below tertiary levels and as such they were mainly working as fishermen and farmers which expose them to the disease.

**Table 4.11: Educational level and the experience of Bilharzia**

Educational level	Ever suffered bilharzia		Total
	Yes	No	
<b>Tertiary</b>	9(4.5%)	1(8%)	<b>10</b>
<b>SHS/Vocational</b>	51(25.8%)	37(30%)	<b>88</b>
<b>JHS</b>	90(45.4%)	50(41%)	<b>140</b>
<b>No education</b>	48(24.2%)	34(17%)	<b>82</b>
	198	123	<b>320</b>

Source: Field Data, 2012.

**Table 4.12: Chi-Square Tests between Educational level and the experience of bilharzia**

	Value	df	Asymp. Sig. (2-sided)
<b>Pearson Chi-Square</b>	4.510	3	.211
<b>Likelihood Ratio</b>	5.210	2	.15
<b>Linear-by-Linear Association</b>	.368	1	.0157
<b>N of Valid Cases</b>	320		

Source: Field Data 2012.

#### **4.4. SPATIO-TEMPORAL ANALYSIS OF SCHISTOSOMIASIS CASES BASED ON HOSPITAL RECORDS**

In addition to the use of primary data, the researcher also relied on secondary data to explain the spatial and temporal patterns of the incidence of schistosomiasis in the study areas, and identify the environmental factors that promote the prevalence of the disease in the endemic study areas. These analyses were in line with the first objective of the study. Two sources of data were relied on for this analysis. First, the researcher relied on hospital records and secondary data provided by the district health services to describe patterns of the disease. Second, data collected from survey respondents on experience with the disease also provide useful information on disease incidence.

#### **4.4.1 Reported cases of Schistosomiasis Disease in health centres within Dangme East and South Tongu Districts**

This study relied on data provided by the Dangme East and the South Tongu District Directorates of Ghana Health Services to assess the temporal trends in the incidence of the disease under investigation.

Although the researcher initially sought to do a trend analysis of disease prevalence for each of the districts for the past 10 years, this was not possible as data was only available for the period between 2009 and 2012 for the Dangme East District and for the period between 2008 and 2011 for the South Tongu District. Tables 4.10a and 4.10b show the distribution of cases of Schistosomiasis for the two districts, as provided by the district directorates of health services.

**Table 4.13 a: Distribution of Schistosomiasis Cases in the Dangme East District by Age (2009-2011)**

Age	≤10	11-20	21-30	31-40	41-50	51-60	61-70	71 <sup>+</sup>	Total	Percent Change
<b>Year</b>										
<b>2009</b>	37	158	30	5	1	0	0	2	<b>233</b>	-
<b>2010</b>	8	7	3	2	0	0	0	0	<b>20</b>	-91.0
<b>2011</b>	5	3	0	4	0	0	0	0	<b>12</b>	-40.0
<b>2012</b>	6	3	2	1	0	0	0	0	<b>12</b>	0.0

Source: Dangme East District Directorate of Health Services, 2013.

**Table 4.10 b : Distribution of Schistosomiasis Disease in the South Tongu District by Age (2008-2011)**

Age	≤10	11-20	21-30	31-40	41-50	51-60	61-70	70 <sup>+</sup>	Total	Percent Change
<b>Year</b>										
<b>2008</b>	21	34	11	18	3	4	0	4	<b>95</b>	-
<b>2009</b>	19	43	9	44	5	5	1	2	<b>128</b>	34.7
<b>2010</b>	34	51	19	49	7	2	2	3	<b>167</b>	30.5
<b>2011</b>	37	60	22	52	9	3	2	4	<b>189</b>	13.2

Source: South Tongu District Directorate of Health Services, 2012

The data shows that in the Dangme East District, the recorded cases of Schistosomiasis declined rapidly from 233 cases in 2009 to 20 in 2010 (i.e. a decline of 91% ) and then to 12 cases in 2011 (a decline of 40%). No further decline was observed in 2012, and this suggests that the decline in prevalence has stalled.

In-depth interviews with health officials in this district revealed that the high incidence rate in 2009 could be attributed to the existence and abundance of several infected water bodies that contain the host snail. A second factor that health officials mentioned was responsible for the high incidence of schistosomiasis in the Dangme East districts prior to

2009 was inadequate health education and awareness of the disease. However, after 2009, an intensive health education was carried out in the districts to create awareness of the schistosomiasis disease and its debilitating effects on human endeavours. The health education drive had positive effects on the populace. It was explained that this health education was what accounted for a decline:

*The number of cases of schistosomiasis was very high before that time [2009]. With support of the government, we took the fight against this disease very seriously. The intensive education in the communities has helped to reduce the number of cases drastically to less than 20 in the whole district. If we get financial support to embark on more education, we can bring the numbers to less than 10 (Anago, an official of the Dangme East District Health Directorate).*

In contrast to the declining incidence witnessed in the Dangme East District, hospital reported Schistosomiasis incidence in the South Tongu District shows increasing trend for the four consecutive years of study from 95 in 2008 to 128 in 2009 (an increase of 34.7%), 167 in 2010 (an increase of 30.5%) and finally 189 in 2011 (an increase of 13.2%).

This steady increase in cases of schistosomiasis in the South Tongu District could be attributed to lack of intensive health education and extensive use and dependence on the Volta River by the various riparian communities in the district for different economic activities. These results show that although both districts have high proportions rate of infections, it has declined in the Dangme East district.

#### **4.4.2 Relationship between Age and Risk of Schistosomiasis infection**

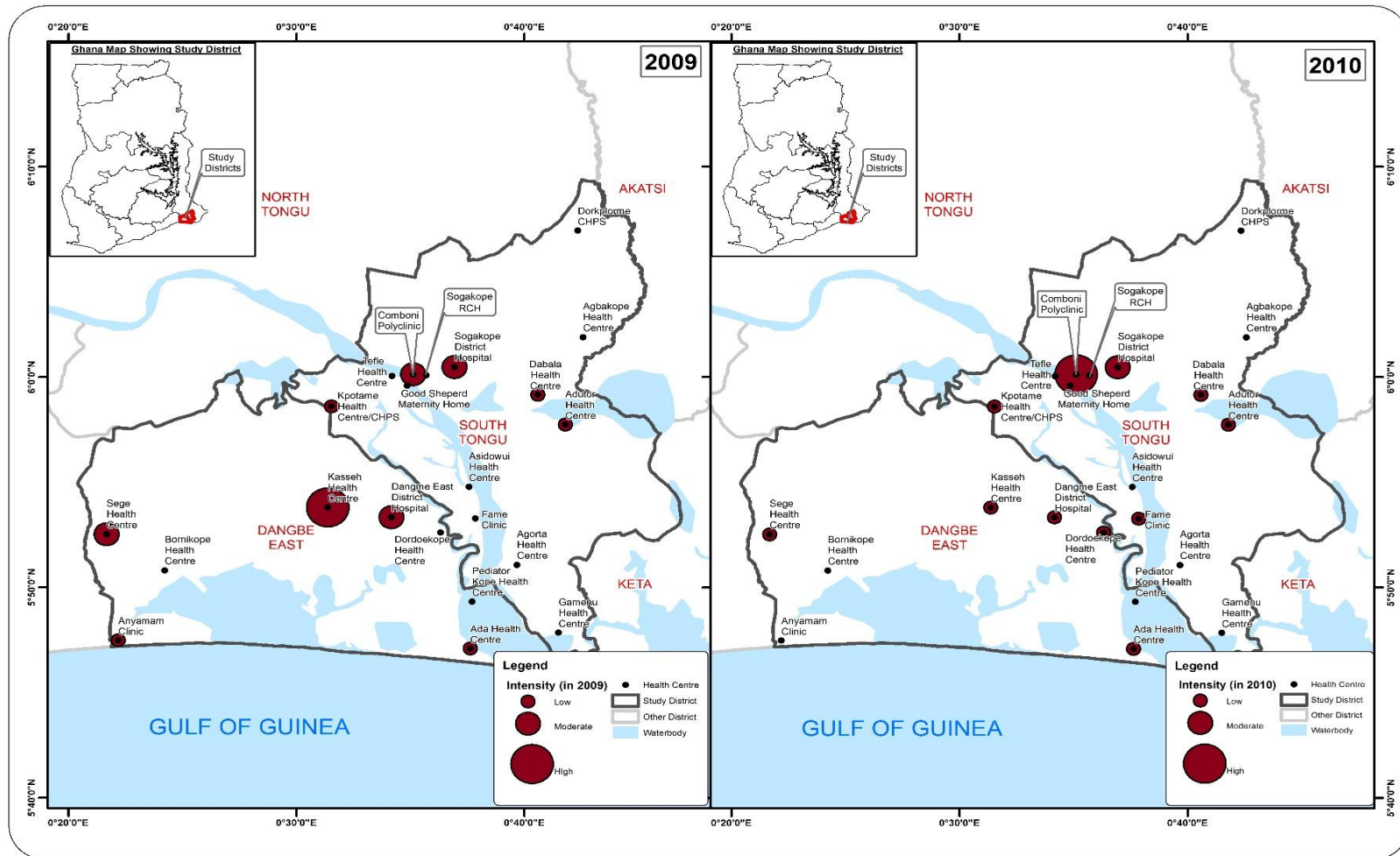
Age is an important variable that influences the distribution of diseases within a population (Anto, 1996). A critical analysis of the figures in tables 4.9a and 4.9b shows that in both districts, there were variations in the incidence of schistosomiasis among

various age groups. In both districts, the highest incidence rate occurred in the age group of 11-20 years followed by 0-10 years. Thus, while statistical test on questionnaire data does not show significant association between age and infection by the disease, hospital data shows that younger people are more likely to be infected by the disease. The high incidence of schistosomiasis disease among this young population is linked to the fact that these groups of people in the riparian communities use river frequently and constantly as their source of drinking water, bathing, washing and swimming. Bathing, washing and swimming activities keep them long in the water enough to facilitate the larvae (*Cercaria*) to penetrate the skin to enter the body to begin its life-cycle in the human body. Additionally, their young tender skin and fragile immune system make them highly vulnerable to infection. In this context, it can be argued that age is part of 'population segment' of the human ecology model which is adopted for this study. The hospital records is consistent with the 2014 USAID report which showed that Schistosomiasis infection is common in children as they tend to engage more in bathing or swimming in water carrying the larval form of the parasite. The findings are consistent with the Ecological model, which indicates that the ability of the population to cope with the various aspects of maladjustment is a function of susceptibility or resistance, its nutritional status, and its immediate physiological status (Meade, 1988), which can be determined by age. Younger people are more susceptible to the disease because of their weak biological system and also their economic activities which make them vulnerable.

#### **4.4.3. A GIS Analysis of Reported Cases of Schistosomiasis in the Dangme East and South Tongu Districts**

The reported/recorded cases of schistosomiasis in the Dangme East and South Tongu District of the Greater Accra and Volta Region respectively were studied. Twenty two (22) health facilities were considered across these two Districts namely; Dangme East District Hospital, Sege Health Centre, Kasseh Health Centre, Ada Health Centre, Pediatorkope Health Centre, Bornikope Health Centre, Kpotame Health Centre/CHPS, Gamenu health Centre, Anyaman Clinic, Sogakope RCH, Sogakope District Hospital, Adutor Health Centre, Tefle Health Centre, Dabala Health Cente, Agorta Health Centre, Asidowui, Health Centre, Agbakope Health Centre, Fame Clinic, Dordoekope CHPS Comboni Polyclinic, Dorkplorme CHPS and Good Sheperd Maternity Home.

The graduated symbol renderer was employed to represent the quantitative information (i.e. of reported cases of schistosomiasis) from 2009 through 2014. Graduated symbols renderer uses quantitative values for a field and groups them in ordered classes. Additionally, all features within a class are drawn using the same symbols and graduated symbols ranges from smallest to largest assigned to each class with smallest size indicating the least range and the bigger size showing larger ranges.



**Figure 4.1: Levels of documented schistosomiasis cases in Dangme East and South Tongu Districts in 2009 and 2010.**

In 2009, the Kasseh Health Centre, as displayed on Figure 4.1, recorded the highest number of schistomiasis cases whilst the Sege Health Centre, Dangme East District Hospital, Comboni Polylinic and Sogakope District Hospital recorded moderate cases. The Dabala Health Centre, Adutor Health Centre, Ada Health Centre, Anyaman Clinic and Kpotame Health Centre received low cases of diagnosed schistosomiasis, however, other health centres at that time recorded no cases at all. The Kasseh Health Centre is a central point for many destinations across the landscape aside having adequate facilities; as a result, it becomes very accessible for individuals from different areas. In addition to adequate facilities to treat the disease, it was observed that individuals who contract the disease access the nearby health centres unless there are no treatment materials.

The Comboni Polyclinic diagnosed the highest number of schistosomiasis in 2010 with moderate cases reported at the Sogakope District Hospital. The reason accounting for this was that a lot more schistosomiasis cases were contracted by communities living in that area along the Lake. Also, the Sege Health Centre, Kasseh Health Centre, Dangme East District Hospital, Dordoekope CHPS, Fame Clinic, Adutor Health Centre, Dabala Health Centre and Kpotame Health Centre / CHPS recorded low cases as there existed a general reduction of reported cases in this year around these health facilities. The remaining health facilities across the two districts spotted no cases of Schistosomiasis as shown also on Figure 4.1.

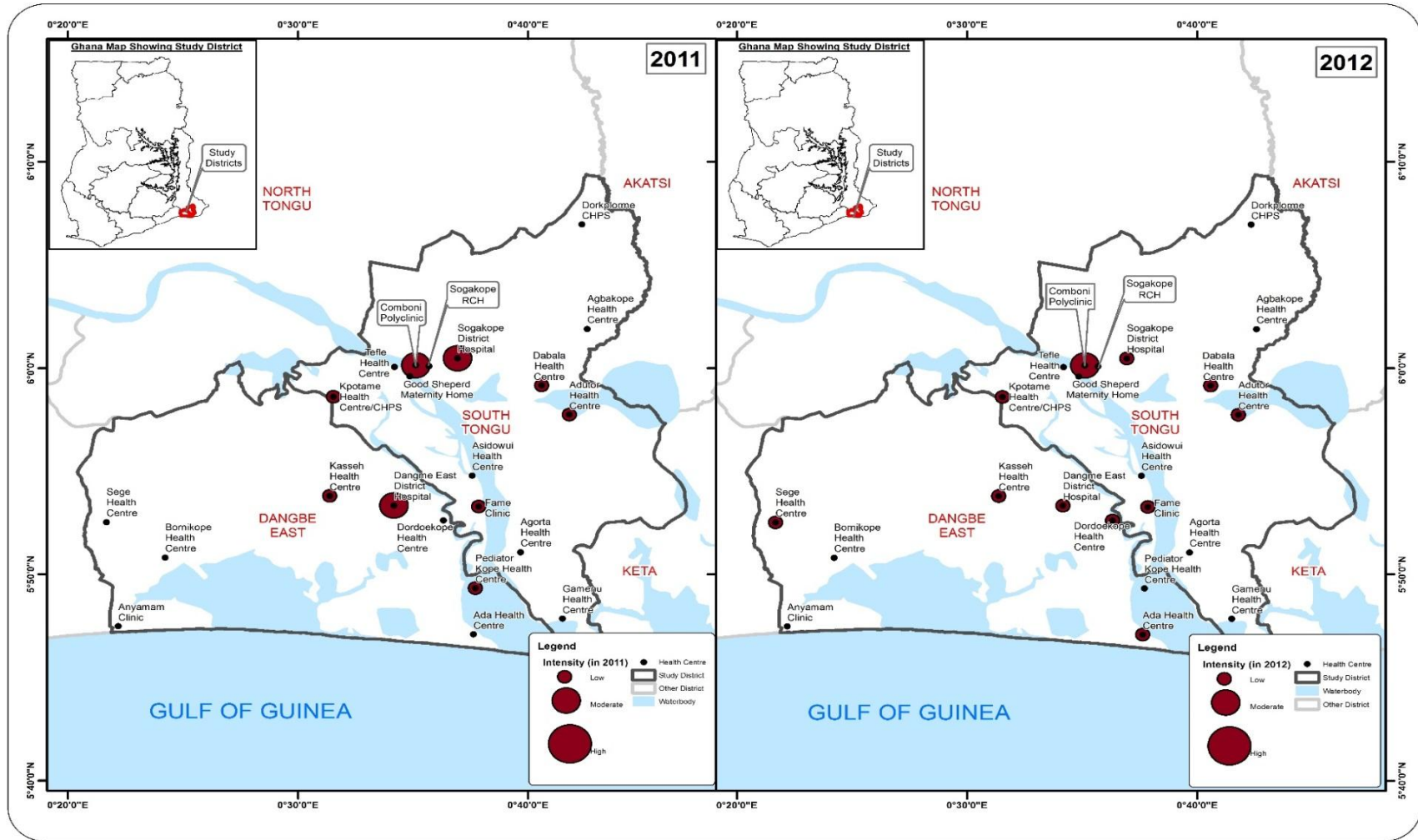
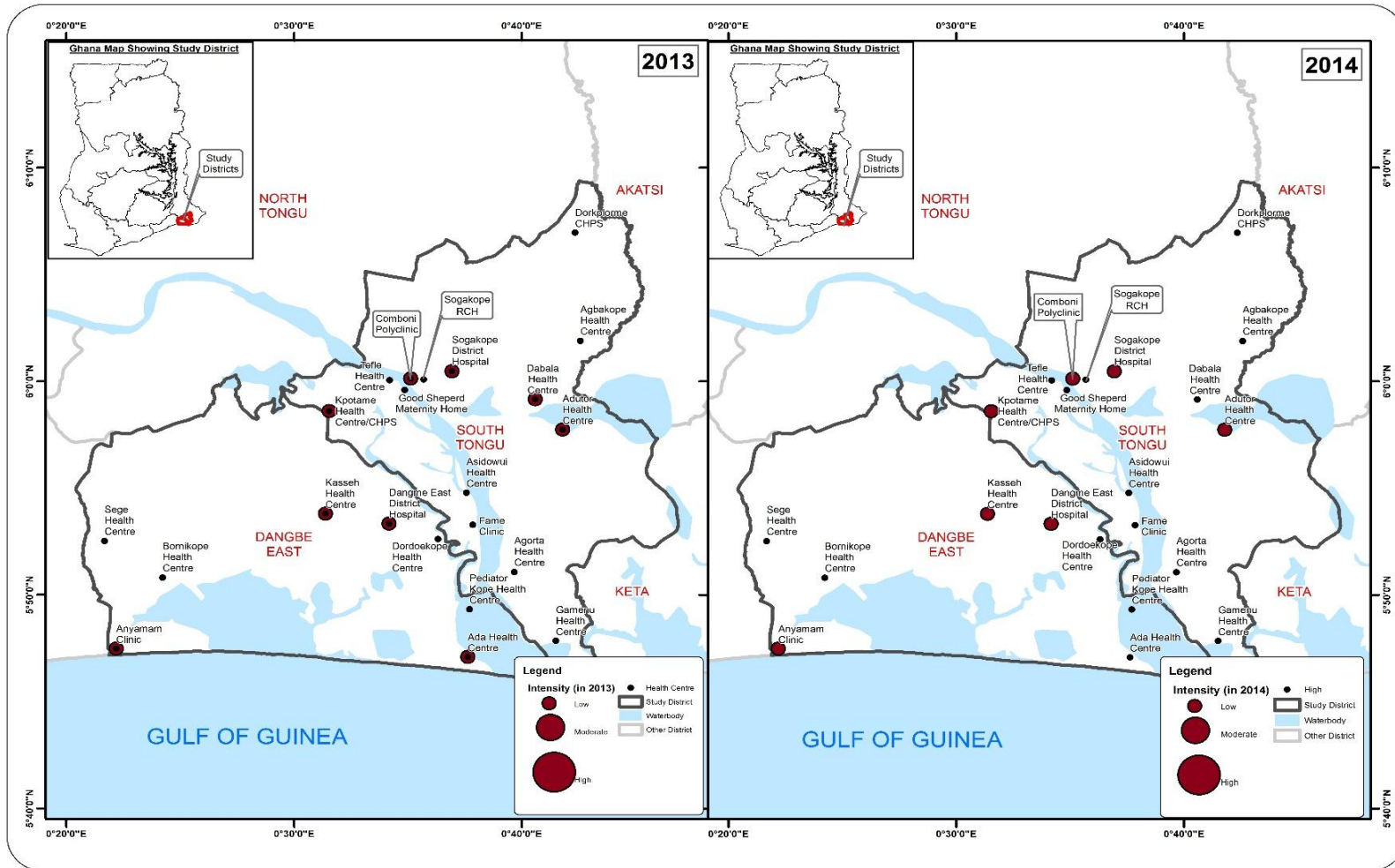


Figure 4.2: Levels of documented schistosomiasis cases in Dangme East and South Tongu Districts in 2011 and 2012.

Figure 4.2 shows the diagnosed cases of the disease in 2011 and 2012 accordingly. There were moderate recorded cases in 2011 at the Comboni Polyclinic, Sogakope District Hospital and the Dangme East District Hospital. It is noteworthy that all the above mentioned health facilities are spotted close to the Volta Lake effectively indicating that the contraction of the disease were prevalent among communities in along that stretch of the Lake in this year as in the year before. Respectively, Kasseh Health Centre, Peditorkope Health Centre, Kpotame Health Centre, Dabala Health Centre as well as the Adutor Health Centre documented low reported or diagnosed cases of the disease. Moreover, other health centres established no cases at all in 2011.

The Comboni Polyclinic, as shown on Figure 4.2 for 2012, was the only health facility that recorded moderate cases indicating the contamination of the waterbody at that enclave by natural and anthropogenic factors necessary for the breeding of the disease. More so, facilities like the Sege Health Centre, Kasseh Health Centre, Dangme East District Hospital, Dordoekope Health Centre, Ada Health Centre, Fame Clinic, Kpotame Health Centre, Sogakope District Hospital, Dabala Health Centre and Adutor Health Centre recorded low cases of the disease whiles the remaining health facilities received no schistosomiasis patients.



**Figure 4.3: Levels of documented schistosomiasis cases in Dangme East and South Tongu Districts in 2013 and 2014.**

On Figure 4.3 for 2013, low cases of the schistosomiasis disease were diagnosed by the Comboni Polyclinic, Sogakope District Hospital, Dabala Health Centre, Aduator Health Centre, Kpotame Health Centre, Kasseh Health Centre, Dangme East District Hospital, Anyamam Clinic and Ada Health Centre. All other health facilities across the two districts recorded nothing.

Similarly in 2014, Anyamam Clinic, Kasseh Health Centre, Dangme East District Hospital, Kpotame Health Centre, Comboni Polyclinic, Sogakope District Hospital and Aduator Health Centre spotted low cases of the disease as shown Figure 4.3. The remaining distributed health facilities have no reported cases.

Effectively, the reduction in reported cases for these respective years was as a result of awareness creation and improvement of conditions that aid in the breeding of disease by health authorities. Another measure was for individuals to report unusual sign and symptoms ascribed to contraction of the disease.

#### **4.5 An Analysis of Factors Responsible for Schistosomiasis Dangme East and South Tongu Districts**

The main factors revealed by the study to be responsible for the high prevalence of schistosomiasis in the study areas were: environmental, developmental, social, attitudinal and economic. Consistent with Meade's theory that recognise importance of environment in disease prevalence, the two study districts have a number of cases of Schistosomiasis because of environmental factors. Location of the study areas in the dry sub-humid tropical climate supply enough heat and sunlight that facilitate the development, survival and flourishing of the vector host snails and schistosome species that infect human

beings. Additionally, the South Tongu and Dangme East Districts are both located in the Lower Volta Basin, south of the Akosombo and Kpong Dams. The Akosombo dam was built in the 1960s, while the Kpong Dam was built in the 1970s. Prior to the construction of these dams, both districts were influenced by the natural flow characteristics of the Volta River. There were fast flow and high floods during the rainy season. This factor made survival and flourishing of schistosomiasis host snails difficult. After construction of the dams, flow downstream slowed and stagnated; the volume of water drastically was reduced and lowered. These factors provided favourable conditions for flourishing of vector snails to prompt fast prevalence rate. It was reported that even though *S. haematobium* was reported in the Volta basin of Ghana before the construction of the Akosombo Dam in 1964, it was not considered a disease of public health importance and concern since the prevalence rate was low. Surveys undertaken by the medical field unit of the Ministry of Health (1959-1961) indicated that schistosomiasis was endemic in all areas of the Volta basin where it was found (Paperna, 1969). However, the construction of the dam up-stream have created several and myriads of ponds, lakes, low volume of water in the main Volta River, shallow and stagnated flow as well as development of marshy vegetation downstream. These conditions have facilitated growth and development of environmental conditions that support development of vector host snails, interaction of the snails with cercariae for fast multiplication and spread. These factors significantly impacted on the high incidence and increase of schistosomiasis in the study areas. In the immediate coastal areas of these districts mangroves grow in the coastal lagoons where the soil is relatively salty and waterlogged. These findings support the argument by some researchers that in most cases large scale dams are often associated with different health problems (Thabane, 2000; Aguiree, 2005).

Additionally, schistosomiasis infects a wide range of animals including dogs, cats, cattle, pigs, sheep, goats and wild rodents which are also common in the two study areas. The faecal droppings of these animals contain the infectious agents of schistosomiasis. The animals also get into contact with water bodies. They drink, bath and walk through the water thus contaminating the source of water. The snails which serve as intermediate hosts for *S. japonicum* (*Oncomelonia* specie) are amphibious (water and land snails). They live mainly on vegetation along river banks and in rice paddies. Their amphibious character increases risk of infection.

The similarity in terms of climate and ecological characteristics (the physical environment) gave rise to similar economic activities of fishing, farming and livestock keeping as well as trading in commodities produced in the two districts. The farming and fishing activities, in particular, expose people in these areas to infections. This can be situated within the context of the conceptual framework which explains that the nature of economic activities undertaken could determine the level of the disease burden.

Despite the identified similarities in location and environmental factors, there exist differences in specific locations and incident rates. As noted, in the Dangme East District, the incident cases illustrated a declining trend while in the South Tongu District, an increasing trend was identified. The decreasing trend in the Dangme East District was due to extensive and intensive education and awareness creation by the District Health Directorate and other stakeholders in health issues such as the Nouguchi Memorial Institute for Medical Research and the University of Ghana Lower Volta Basin Research Project, hence improvement in sanitation habit of the people (Dangme East District Directorate of Health Services, 2011). Furthermore, the extreme Eastward location of the

Dangme East District along the coast has created salinity conditions both in soil and surrounding water bodies. An environmental condition that is inimical to the survival and flourishing of the schistosomiasis host snails. In contrast to the decreasing trend in the Dangme East District, the South Tongu District was characterized by a steady increasing incidence rate. The increasing trend was attributed mainly to inadequate education and paucity of potable water facilities in the districts coupled with poor sanitation.

#### **4.6. Anthropogenic behaviours and the Incidence of the Schistosomiasis Disease**

To find the anthropogenic behaviours which underpin the incidence of the disease in the two study areas, the researcher asked questions about the number of times respondents come into contact with water bodies, the mode of treatment and the last time of treatment. The researcher went ahead to examine the relationships between some anthropogenic behaviours of respondents and age, sex, educational level and income level.

**Table 4.14: Number of times of contact with contaminated water**

	<b>Dangme East</b>	<b>South Tongu</b>
<b>Daily</b>	58(36.3%)	61(38.1%)
<b>1-3 times per week</b>	59(36.9%)	63(39.4%)
<b>4-6 times per week</b>	28(17.5%)	24(15.0%)
<b>Once per week</b>	10(6.3%)	8(5.0%)
<b>Once a week</b>	5(3.1%)	4(2.5%)
<b>Total</b>	<b>160 (100%)</b>	<b>160 (100%)</b>

Source: Field Data 2012.

Table 4.11 shows the number of times respondents come into contact with water bodies. The results show that a significant proportion of respondents come into contact with water frequently. In fact, 36% of respondents in Dangme East and 38% of their counterparts in South Tongu came into contact with water on daily basis. Another 37% of respondents in Dangme East and 39% of their counterparts in South Tongu districts reportedly came into contact with water 1-3 times weekly. The in-depth interviews suggest that people come into water frequently due to activities such as the fetching of water primarily for washing, bathing and cooking as well as their engagement in economic activities including fishing and farming. This is evidenced in an interview with a 42 year old man who has been affected several times with the disease as quoted below:

*I know the reason why I have been in this trouble over and over. As a fisherman, I am always in the water and so it is difficult for me to avoid the disease. Assuming the government has helped us to get a factory here so that we stop this fishing work, many of us will not be free from this painful disease.*

The statement above shows how economic activities expose several people to this disease. Their responses support the postulation by Meade's theory (see chapter 2) that behaviour is a key determinant of vulnerability to certain diseases. This results is also in agreement with the information gathered at the district health directorate of the two districts which suggests that behavioural factors that bring people into contact with contaminated water is one of the major factors that contribute to the high incidence of the disease.

These findings are also consistent with the findings of the USAID (2014) report that people get infected with schistosomiasis by coming into contact with contaminated water containing schistosome parasites while engaging in such activities as bathing, swimming,

or performing everyday household tasks, including laundry, herding animals and fetching water. To this extent, patterns of hygiene, water delivery, and human water usage are critical factors in identifying the risk of infection.

#### **4.7 Chapter Summary**

The analysis in this chapter shows that a significant proportion of respondents in both the Dangme East and South Tongu have ever been infected with schistosomiasis. Young people are more predisposed to infection compared to the older people in the two study areas. Males are more susceptible to schistosomiasis than females because of the nature of their work always brings them in contact with water bodies. The high level of public education of the disease led to an increase in reported cases of schistosomiasis hospitals and health centres in the Dangme East District, but the South Tongu District still records quite high prevalence of the disease. In line with the conceptual framework adopted, socio-economic and environmental issues are reasons for the predominance of schistosomiasis in the two study districts. The inadequate supply of portable water in most parts of the districts and occupational activities in the area were some of the factors that predispose people to infections.

## CHAPTER FIVE

### KNOWLEDGE, PERCEPTIONS AND MANAGEMENT OF SCHISTOSOMIASIS DISEASE

#### 5.1. Introduction

The importance of the knowledge base and perceptions in behaviour cannot be over emphasized. This chapter, therefore, examines the knowledge of respondents about the disease. The chapter also discusses the human activities that tend to expose people to this infection and presents the measures adopted by the people to tackle the disease.

#### 5.2 Knowledge about the disease

Table 5.1 shows respondents knowledge of how bilharzia is contacted according to the most important mode of contracting the disease. The table shows that from the point of view of respondents, the most important mode of contracting the disease are: contact with contaminated water bodies, drinking and bathing, breathing contaminated air and by breathing infected air.

**Table 5.1: Knowledge of most important factor on how Bilharzia is contacted**

	Number	Percentage
<b>Contact with contaminated water</b>	144	45.0
<b>By drinking and bathing</b>	130	40.6
<b>By drinking and bathing</b>	18	5.6
<b>By eating contaminated fish</b>	28	8.8
<b>Total</b>	<b>320</b>	<b>100.0</b>

Source: Field data, 2012.

Contact with contaminated water was the most widely known mode of transmission, cited by 45% of respondents. This was followed closely by ‘drinking and bathing’ which was cited by nearly 41% of respondents. The researcher also examined the relationships between perception of how the disease is contacted on one hand and, age, sex and education on the other hand. In terms of relationship between age and perception of how disease is contracted, it was found that younger people less than 18 years were more likely to cite ‘drinking and bathing’ (54%), while older people were more likely to cite ‘contact with contaminated water’ (cited by 50% of those in 18-35 year group and 67% of those in 36-60 year group) as the main cause of the disease. To test whether there exist a statistically relationship between age and knowledge of how the disease is contacted, Pearson Chi-Square test was used as presented in table 5.18. The Chi-Square results give a Chi-Square value of 32.443 and a probability value of 0.000 at 5% significance level suggesting that there exist a statistically significant relationship between age and knowledge of how the disease is contacted and that older respondents are more knowledgeable about how the disease is contacted than younger respondents. For instance, one of the respondents, who was over 65 years indicated that younger people in the area lack knowledge about the disease and should seek better understanding of how the disease is contracted from the older population. Another respondent who was 54 years stated that *“I think I am knowledgeable about the disease because I am over 60 year”*. This clearly shows how older people believe that they have better understanding of the disease than younger people.

The fact that majority of the people mentioned contact with contaminated water as the cause of infection resonates with the 2014 USAID report which suggested that people get infected with schistosomiasis by coming into contact with contaminated water containing

schistosome parasites while engaging in such activities as bathing, swimming, or performing everyday household tasks, including laundry, herding animals and fetching water. The results of the study are also confirmed by a study by Alika (2013) who found that humans activities which include cooking, drinking bathing, washing, farming, fishing, masonry, swimming, wading and religious washing of the body-ablution and baptism can cause infection (Alika, 2013).

**Table 5.2: Knowledge on most important mode of contracting bilharzia**

How is bilharzia contacted	Age				Total
	Less than 18	18-35	36-60	60 and over	
<b>Contact with contaminated water</b>	39(32.2)	52(49.5)	42(66.7)	11(35.5)	<b>144</b>
<b>By drinking and bathing</b>	66(54.5)	34(32.4)	18(28.6)	12(38.7)	<b>130</b>
<b>By breathing infected air</b>	5(4.1)	9(8.6)	2(3.2)	2(6.45)	<b>18</b>
<b>By eating contaminated fish</b>	11(9.1)	10(9.52)	1(1.6)	6(19.4)	<b>28</b>
<b>Total</b>	<b>121</b>	<b>105</b>	<b>63</b>	<b>31</b>	<b>320</b>

Source: Field Data, 2012.

**Table 5.3: Chi-Square Tests between Age and how bilharzia is contacted**

	Value	df	Asymp. Sig. (2-sided)
<b>Pearson Chi-Square</b>	32.443	9	.000
<b>Likelihood Ratio</b>	32.768	9	.000
<b>Linear-by-Linear Association</b>	1.465	1	.226
<b>N of Valid Cases</b>	320		

Source: Field Data 2012.

The relationship between sex and knowledge of how the disease is contacted is presented in Table 5.4. The descriptive results show that majority of males indicated that the disease is contacted by ‘drinking and bathing with the water while majority of the females maintain that the disease is contacted through contact with the contaminated water. The Chi Square-Square results, however, indicate that there is no significant relationship between sex and knowledge of how the disease is contacted ( $X^2 = 1.744$ ,  $df = 3$ ,  $P = 0.627 > 0.5$ ).

**Table 5.4: Sex and knowledge on most important mechanism of contracting bilharzia**

How is bilharzias contacted	Sex		Total
	Male	Female	
Contact with contaminated water	64(41.3)	80(48.5)	144
By drinking and bathing	68(43.9)	62(37.6)	130
By breathing infected air	9(5.8)	9(5.5)	18
By eating contaminated fish	14(9.1)	14(8.5)	28
<b>Total</b>	<b>155</b>	<b>165</b>	<b>320</b>

Source: Field Data, 2012.

On the relationship between educational level and knowledge of how the disease is contacted, the results show that majority of respondents at all levels of education (60% of those with tertiary education; 53% of those with SHS and 58% of those with JHS) maintained that the disease is contacted by drinking and bathing with the contaminated water ( see Table 5.5). The Chi-Square results (Table 5.6) give a statistically significant probability value of 0.004 at 5% significant level indicating that there exist a statistically significant relationship between educational level and knowledge of how the disease is contacted and that as one climbs the educational ladder. People with tertiary education were found to attribute the disease to scientific cause more than uneducated people. One man with tertiary education stated that:

*“I have better knowledge of the disease because of my level of education and that education remain the key to understanding the mysteries of the disease.”*

**Table 5.5: Educational level and knowledge about how bilharzia is contacted**

How is bilharzias contacted	Educational level				Total
	Tertiary	SHS/Vocational	JHS	No education	
Contact with contaminated water	2(20%)	38(43%)	53(37.9%)	47(58%)	140
By drinking and bathing	6(60%)	47(53.4%)	57(40.7%)	24(29.6%)	134
By breathing infected air	0(0%)	3(3.4%)	12(8.6%)	3(3.7%)	18
By eating contaminated fish	2(20%)	1(1%)	18(12.9%)	7(8.6%)	28
<b>Total</b>	<b>10</b>	<b>88</b>	<b>140</b>	<b>81</b>	<b>320</b>

Source: Field Data, 2012.

**Table 5.6: Chi-Square Tests between Educational level and how bilharzia is contacted**

	Value	df	Asymp. Sig. (2-sided)
<b>Pearson Chi-Square</b>	24.555 <sup>a</sup>	9	.004
<b>Likelihood Ratio</b>	28.085	9	.001
<b>Linear-by-Linear Association</b>	.051	1	.822
<b>N of Valid Cases</b>	320		

Source: Field Data 2012.

To further examine the knowledge of respondents about the disease, the researcher asked respondents how they know one has the disease. The results in Table 5.7 show that majority 51% and 54% of the respondents in Dangme East and South Tongu,

respectively maintain that one gets to know he has the disease if he/she sees blood in his or her urine. Thier results is consistent with the literature as blood in urine is indeed is a symptom of the disease (Tay, Amankwa & Gbedema, 2011).

**Table 5.7: Most important symptom of bilharzia infection**

How does one know that he has bilharzia	District		Total
	Dangme East	South Tongu	
Difficulty in urinating	61(38%)	53(33%)	<b>114</b>
Blood in urine	82(51.25%)	86(53.75%)	<b>168</b>
Blood in faeces	8(5%)	12(7.5%)	<b>20</b>
Vomiting of blood	4(2.5%)	5(3.1%)	<b>9</b>
Abdominal pains	5(3.1%)	4(2.5%)	<b>9</b>
<b>Total</b>	<b>160</b>	<b>160</b>	<b>320</b>

Source: Field Data, 2012.

The information and knowledge about the organism responsible for the transmission of schistosomiasis is presented in Table 5.8. The results show that 75% of the respondents believed that water snail was the organism responsible for the transmission of the disease.

One respondent, for instance, mentioned that “*I have known that the organism responsible for the disease is water snails since childhood*”. This is a clear indication that majority of the people are aware of the organism causing the disease.

Also, about 6% were of the view that water flies were responsible for the disease because they are constantly bitten by flies hatched in and around water bodies. Again, approximately 12.5% of the respondents were of the conviction that fishes were responsible for the disease transmission, especially fish eaten that is not well cooked. Also approximately 3% were also of the view that oysters were responsible for transmission of schistosomiasis disease and 3.4% mentioned lobsters and the main organisms responsible for the transmission of the disease.

**Table 5.8: Knowledge of the organism responsible for the transmission of bilharzia**

Organism responsible for the transmission of bilharzia	District		Total
	Dangme East	South Tongu	
Water snails	125(78.1)	115(71.8)	<b>240</b>
Water flies	10(6.25)	9(5.6)	<b>19</b>
Fishes	18(11.25)	22(13.75)	<b>40</b>
Oysters	4(2.5)	6(3.75)	<b>10</b>
Lobsters	3(1.9)	8(5)	<b>11</b>
<b>Total</b>	<b>160</b>	<b>160</b>	<b>320</b>

Source: Field Data, 2012.

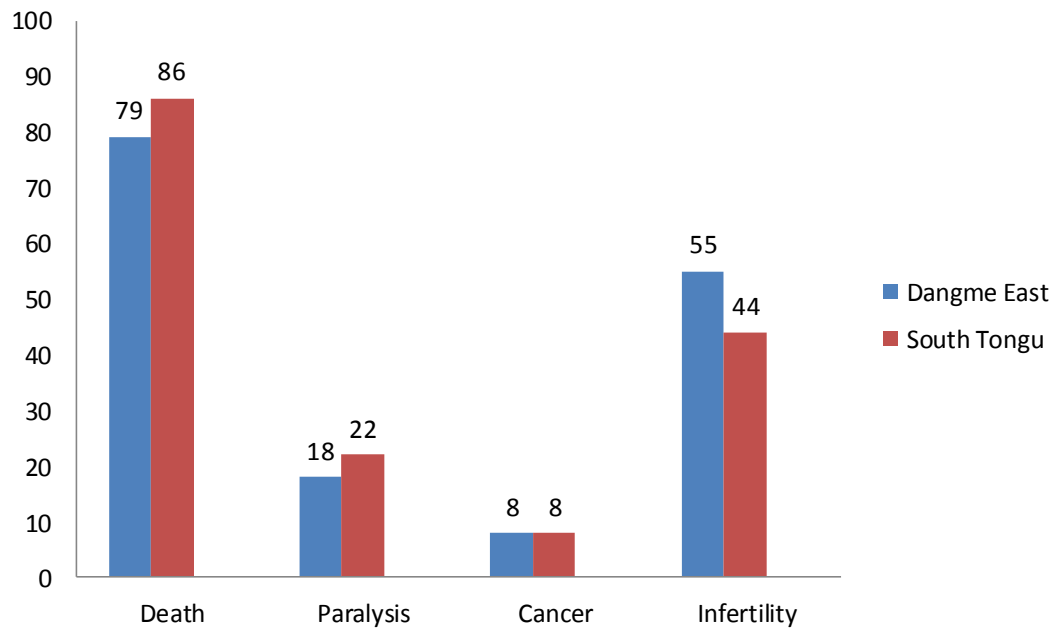
The respondents were also asked about the factors that contribute to the high incidence of the disease and went ahead to examine if there exist correlations between the perception of the factors that cause the disease and age, sex and education. The results in Table 5.9 show the factors identified by respondents as contributing to the high prevalence of the disease. The results show that the ranking of perception from the highest to the lowest include, the presence of contaminated water bodies, punishment from the gods, poverty, ignorance of the disease, lack of education on the disease, literacy and absence of health facility in the districts. These findings are consistent with earlier findings reported elsewhere. One key informant noted that of all these factors poverty is the most critical because it pushes people into fishing and other risky income generating activities. At the same time, poor people are unable to seek early treatment when affected by the disease. Sady et al. (2013) have also identified schistosomiasis as a poverty-related disease, as confirmed by this study. According to Steinmann *et al.* (2006) and Engels *et al.*, (2002), poverty with resultant poor housing, absence of clean water and insufficient hygienic environments predispose people to this disease.

**Table 5.9: Factors which contribute to the high incidence of bilharzias (Multiple responses)**

<b>Factors</b>	<b>N</b>	<b>Mean</b>	<b>Std. Deviation</b>
<b>Presence of contaminated water bodies</b>	320	3.1515	.87039
<b>Lack of health facilities</b>	320	2.9091	.94748
<b>Poverty</b>	320	2.8485	1.12142
<b>Lack of education on the disease</b>	320	2.8182	.88227
<b>Punishment from the gods</b>	320	2.7576	.83030
<b>Ignorance of the disease</b>	320	2.8182	.88227
<b>Illiteracy</b>	320	2.6970	1.10354
	320	3.1515	.87039

Source: Field data, 2015.

In their response to the question on the effect of schistosomiasis, the result as presented in Figure 5.1 show that 52% mentioned death as the main consequence of contracting the disease, 31% of respondents noted that schistosomiasis could cause infertility in people, 12.5% indicated that schistosomiasis could cause paralysis and 5% mentioned that it could cause cancer. This development clearly showed that schistosomiasis is a killer disease as indicated by the overwhelming number of the respondents in support of this assertion. There are, however, no spatial variations in the experience of the disease as there was not much difference in the perception of the disease in the Dangme East District and the South Tongu District.



**Figure 5.1: Perceptions of effects of contracting bilharzia**

Source: Field Data, 2012.

### 5.3. Coping Strategies and Management of schistosomiasis by Patients and Victims

#### 5.3.1. Treatment of disease

Table 5.10 shows what the respondents do when they are infected with the disease. The results suggest that majority (48.8%) of the respondents visited hospital when they got infected with the disease, 17.4% used herbal medicine, 18.9% engaged in self-medication and 14.9% did nothing when they were infected with the disease. The percentage that mentioned they use herbal medicine is quite high, given what we know that the scientific community does not believe that herbs are effective for curing this disease. In the in-depth interviews, a respondent mentioned that the herbal medicine is effective and was used by their forefathers: *“Our forefather had cure for the disease long before the white man came to this country.”* This was confirmed by the Ghana Health Services, Ada Foah during a follow up to ascertain the authenticity of the

response by the interviewee. It was found out that most of the people affected by the disease under study usually resorted to traditional medication. It was only severe cases that patients reported to health facilities.

**Table 5.10: Mode of treatment of schistosomiasis attack**

<b>Mode of Treatment</b>	<b>Dangme East</b>	<b>South Tongu</b>	<b>Total</b>	<b>Percentage</b>
<b>Visited Hosp.</b>	41(47.7%)	57(49.6%)	98	48.8
<b>Used Herb. Med</b>	19(22%)	16(13.9%)	35	17.4
<b>Bought drug</b>	14(16.3%)	24(21%)	38	18.9
<b>Nothing</b>	12(14%)	18(15.6%)	30	14.9
<b>Total</b>	<b>86</b>	<b>115</b>	<b>201</b>	<b>100</b>

Source: Field Data, 2012

### **5.3.1.1 Age and mode of treatment**

The cross tabulation in Table 5.11 shows the relationship between age and mode of treatment of the schistosomiasis disease. The results indicates that for those who visited hospitals when infected with the disease, majority were between the ages of 18-35 as they constituted 76.5% of the total number of respondents who visited hospitals when infected with the disease. For respondents who used herbal medicine, majority (51%) of them were in the group 36-60 whiles majority (48.6%) of the respondents who engaged in self-medication were in the age group 18-35. The result thus suggests a relationship between age and mode of treatment.

**Table 5.11: Age and mode of treatment**

Age	Mode of Treatment				Total
	Visited a health facility	Used herbal medicine/herbalist	Self-medication	Did nothing about it	
<b>Less than 18</b>	9(9.2%)	3(8.6%)	5(13%)	7(23.3%)	<b>24</b>
<b>18-35</b>	75(76.5%)	5(14.3%)	17(44.7%)	11(36.6%)	<b>108</b>
<b>36-60</b>	11(11.2%)	18(51.4%)	10(26.3%)	7(23.3%)	<b>46</b>
<b>60 and over</b>	4(4)	9(25.7%)	6(15.8%)	5(16.67%)	<b>24</b>
<b>Total</b>	<b>98</b>	<b>35</b>	<b>38</b>	<b>30</b>	<b>201</b>

Source: Field Data, 2012

The chi-Square test (see Table 5.12) shows a Chi-Square value of 32.956 with a significant figure of 0.001 at 5% significant level. Since the probability value of 0.000 is more than the significant level of 0.05, it is concluded that, there is a statistically significant relationship between age and mode of treatment of the disease. The implication of this is that age matters when it comes to the mode of treatment of the disease. The findings suggest that children are more likely to visit hospital when infected, while older people are more likely to use herbal medicine.

**Table 5.12: Chi-Square Tests on Age and mode of treatment**

	Value	df	Asymp. Sig. (2-sided)
<b>Pearson Chi-Square</b>	32.956 <sup>a</sup>	9	.001
<b>Likelihood Ratio</b>	32.197	9	.001
<b>Linear-by-Linear Association</b>	12.616	1	.001
<b>N of Valid Cases</b>	201		

Source: Field Data, 2012

### 5.3.1.2 Sex and Mode of Treatment

The relationship between sex and mode of treatment of the diseases is presented in Table 5.13 and the results indicate that a higher proportion of female (57%) visited hospitals when infected with the diseases than their male counterparts (41%). Males were more likely to use herbal medicine, engaged in self-medication and or do nothing about the diseases when infected. To confirm or deny this conclusion, the study uses Pearson Chi-Square to establish the relationship between sex and mode of treatment and whether this relationship is statistically significant.

**Table 5.13: Sex and mode of treatment**

Sex	Mode of treatment				Total
	visited a health facility	used herbal medicine/ herbalist	Self-medication	Did nothing about it	
Male	42(41%)	22(21.6%)	21(21%)	17(16.67%)	<b>102</b>
Female	56(56.6%)	13(13%)	17(17%)	13(13%)	<b>99</b>
<b>Total</b>	<b>98</b>	<b>35</b>	<b>38</b>	<b>30</b>	<b>201</b>

Source: Field Data, 2012

The chi-Square test (see Table 5.14) shows a Chi-Square value 5.875 with a probability value of 0.118 at 5% significant level. Since the probability value of 0.118 is more than the significant level of 0.05, we conclude that, there is no statistically significant relationship between sex and the mode of treatment of the disease. The implication of this is that there is no statistically significant relationship between sex and the mode of treatment of the disease.

**Table 5.14: Chi-Square Tests on Sex and mode of treatment**

	Value	df	Asymp. Sig. (2-sided)
<b>Pearson Chi-Square</b>	5.875 <sup>a</sup>	3	.118
<b>Likelihood Ratio</b>	5.927	3	.115
<b>Linear-by-Linear Association</b>	4.006	1	.045
<b>N of Valid Cases</b>	201		

Source: Field Data, 2012

### 5.3.1.3 Educational Level and Mode of Treatment

The relationship between the educational level of respondents and the mode of treatment of the disease is presented in Table 5.15. The findings show that at all levels of education, a majority of respondents visited the hospital when they were infected by the disease. However, the proportion of respondents who visited hospital was highest among people with tertiary education (66%) and lowest among people with JHS (36%). A chi square test of independence shows (Table 5.16) that there is a strong relationship between level of education and mode of treatment of the disease ( $X^2=18.560$ ,  $P=0.029 < 0.05$ ). The implication of this is that education matters when it comes to the mode of treatment of the disease. The result have shown that there seem to be some relationship between educational level and the mode of treatment of the disease and as one climbs the educational ladder, the more conscious he/she become on his/her health issues

**Table 5.15: Educational level and mode of treatment**

<b>Educational Level</b>	<b>Visited a health facility</b>	<b>Used herbal medicine/herbalist</b>	<b>Self-medication</b>	<b>Did nothing about it</b>	<b>Total</b>
<b>Tertiary</b>	6(66%)	1(11%)	2(22%)	0(0%)	<b>9</b>
<b>SHS/Vocational</b>	43(57.3%)	11(14.6%)	13(17.3%)	8(10.6%)	<b>75</b>
<b>JHS</b>	26(36%)	20(27.8%)	17(23.6%)	9(12.5%)	<b>72</b>
<b>No education</b>	23(51%)	3(6.7%)	6(13.3%)	13(28.9%)	<b>45</b>

Source: Field Data, 2012.

**Table 5.16: Chi-Square Tests on Educational level and mode of treatment**

	<b>Value</b>	<b>df</b>	<b>Asymp. Sig. (2-sided)</b>
<b>Pearson Chi-Square</b>	18.560 <sup>a</sup>	9	.029
<b>Likelihood Ratio</b>	19.647	9	.020
<b>Linear-by-Linear Association</b>	.258	1	.611
<b>N of Valid Cases</b>	201		

Source: Field Data, 2012

#### 5.3.1.4 Income Level and Mode of Treatment

Table 5.17 shows the relationship between income level of the respondents and the mode of treatment of the bilharzia disease. The results show that that the proportion of respondents that visited the hospital upon infection increased significantly with income from 12% among those in the lowest income group (monthly income less than GHC 50) to 84% among those in the highest income category (above GHC 300 per month). Conversely, people in the lower income category were found to be more likely adopt self-medication or do nothing when infected. An example is when one respondent

exclaimed that “*if I had money, I don’t think my situation will be as bad as it is now.*” It was established that this particular respondent was a young male of fifteen years of age from a poor socio-economic background. He did not visit any health facility at the early stages of the infection and this accounted for his bad situation.

To ascertain if this relationship is statistically significant, a Pearson Chi-Square to test was employed .Table 5.18.

**Table 5.17: Income level and Mode of Treatment**

Average income per month	Mode of Treatment				Total
	Visited a health facility	Used herbal medicine/ herbalist	Self-medication	Did nothing about it	
<b>Below GHC 50</b>	6 (12%)	17(34%)	12(24%)	15(30%)	<b>50</b>
<b>GH 50-GHC150</b>	25(37%)	12(18%)	19(28%)	12(17%)	<b>68</b>
<b>GHC150-GHC300</b>	40(78%)	4(8%)	5(10%)	2(3.9)	<b>51</b>
<b>Above GHC 300</b>	27(84%)	2(6%)	2(6%)	1(3%)	<b>32</b>

Source: Field data, 2012

The Pearson Chi-Square in table 5.18 shows a Chi-Square value of 28.241 with a probability value of 0.001 which is less than the 0.05 significance level suggesting that there exist a statistically significant relationship between income level and mode of treatment and that the different income groups behave differently when it comes to the mode of treatment of the disease.

**Table 5.18: Chi-Square Tests on Income level and Mode of Treatment**

	Value	df	Asymp. Sig. (2-sided)
<b>Pearson Chi-Square</b>	28.241 <sup>a</sup>	9	.001
<b>Likelihood Ratio</b>	31.298	9	.000
<b>Linear-by-Linear Association</b>	5.003	1	.025
<b>N of Valid Cases</b>	201		

Source: Field Data, 2012

The result is consistent with the findings of Sady et al. (2013) who argued that schistosomiasis as a poverty-related disease.

### 5.3.1.5 Last Treatment Time of the Disease

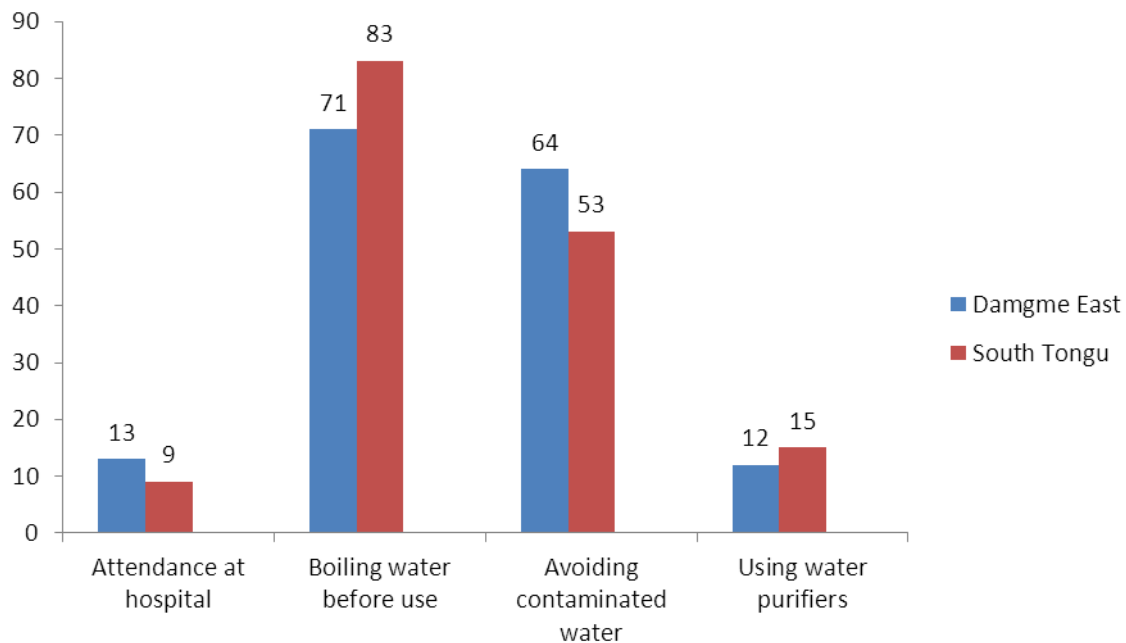
Table 5.19 shows the respondents' last time of treatment of the disease in the two study areas. The findings show that 35% of the total number of the respondents who have ever been infected with the disease had their last treatment of the disease less than a year ago, 35% had their last treatment between 1 and 2 years ago, 17.9% had their last treatment between 2 and 3 years ago and 11.4% had their treatment more than three years ago. It is obvious from the results that majority (70%) of the respondents who have ever experienced the disease had treatment at least two years ago. This is evidenced by the explanation of one respondent, who explained, and I quote "*Why should I visit the hospital when I am ok.*" This was a thirty year old fisherman, who could afford to pay for the bills of his medical treatment, but decided not to visit any health facility. This is a clear indication that people are not ready to treat the disease until they feel very sick or are seriously affected with the disease.

**Table 5.19: Last Treatment Time**

Last Treatment	Dangme East	South Tongu	Total	Percentage %
≤ 1 year ago	43	28	71	35
1–2 years ago	32	39	71	35
2-3 years ago	19	17	36	17.9
≥ 3 years ago	15	8	23	11.4

Source: Field Data, 2012.

The respondents were also asked questions about how they prevented the disease. About 48% of the respondents mentioned the technique of boiling water for safe drinking, 36.5% mentioned the avoidance of contact with contaminated water bodies, 8% mentioned the use of water purifiers and 6.9% visited hospitals regularly to check their health status. This information is presented in Figure 5.2. The observation here was that the various preventive measures by the people achieved desirable results.

**Figure 5.2: Coping Strategies and Management of Schistosomiasis**

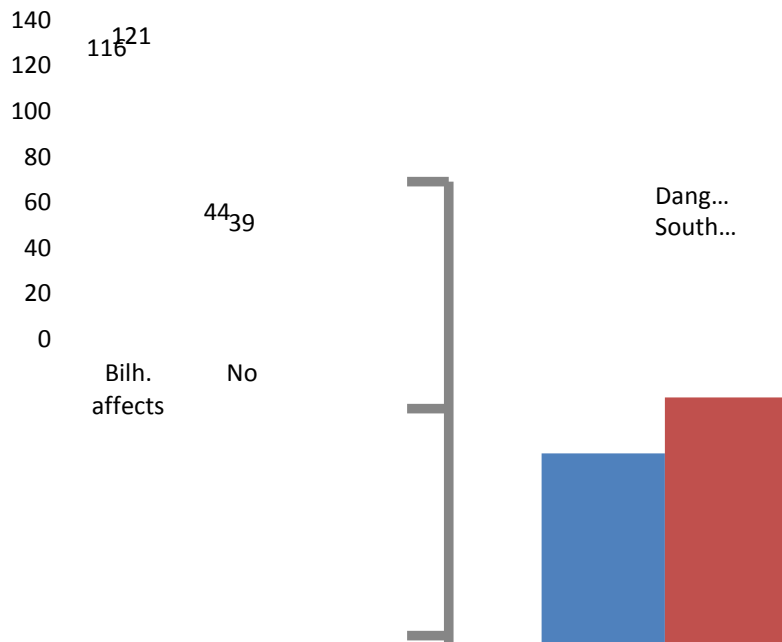
Source: Field Data, 2012.

#### **5.4 Impact of schistosomiasis Infection on Individuals in Endemic Communities**

Studies have shown that schistosomiasis infection has dire consequences for its victims in endemic communities and the government. The effects are particularly manifested economically, socially, culturally, educationally and health wise. In this research, a number of respondents mentioned these effects. One respondent, for instance, explained that *“because of the disease, I am unable to work to look after my children.”* This clearly shows how the disease has affected not only the economic condition of this victim, but also the education of his children. These results are also confirmed by the 2014 USAID report which shows the disease interrupts school attendance (USAID, 2014). Thus, the general liveliness and academic performance of children infected is affected in school as confirmed by the study conducted by McGarvey (2000).

##### **5.4.1: Economic Effects of schistosomiasis in South Tongu and Dangme East district**

Schistosomiasis particularly affects rural, agricultural and fishing population and this is an attribute affected with riverine communities in the study area. The disease is a debilitating one that renders its victims weak, thus making them incapable of undertaking vigorous and effective economic activities for survival and sustenance which eventually affect their production capacity and income status of both the individual and the family. This was aptly captured by a farmer interviewed in the field: *when I had this disease, it was almost impossible for me to cope with my daily economic activities; during this time I had difficulty getting money to support my family.* When respondents were asked if bilharzia have any effect on their economic activity, 74% mentioned yes and 26% mentioned. This is illustrated in Figure 5.3.

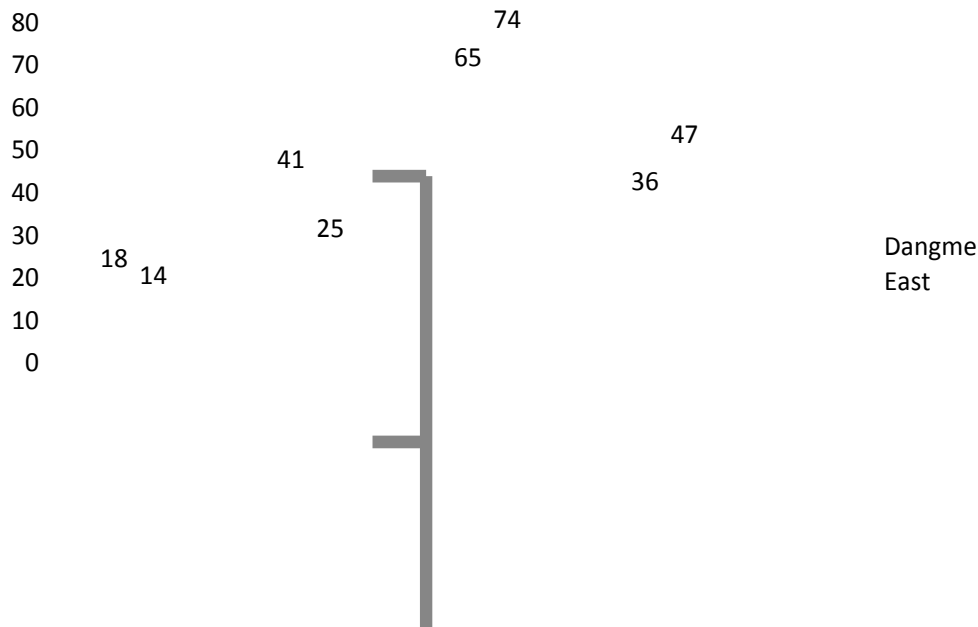


**Figure 5.3: Effect of bilharzia on economic activity**

Source: Field Data, 2012.

In Figure 5.3, the 'Yes' response means bilharzia has an effect on economic activity whereas the 'No' response means bilharzia has no effect on economic activity. About 61% of the respondents stated that they experienced a reduction in their income levels due to schistosomiasis infection. The study results show that majority (73%) of respondents spend between GHC50 and GHC300 in preventing the disease which is quiet high in a developing country such as Ghana. Specifically, approximately 10% of the respondents spend the least amount of GH¢50.00 on schistosomiasis management while nearly 64% spend as much as GH¢300.00 on schistosomiasis management. These expenditures cause a financial drain and burden on the patients, given their rural setting and little profiting and unsustainable economic activities as well as the debilitating

nature of schistosomiasis that weaken the patients and therefore rendering them unable to work. According to Bosompem et al., (2004) this range of expenditure is relatively high.



**Figure 5.4: Expenditure on bilharzia management**

Source: Field data, 2012.

#### **5.4.2 Socio-cultural Impacts of schistosomiasis Infection in Dangme East and South Tongu Districts**

There are latent socio-cultural effects on bilharzia patients. Interviews with health experts in the area revealed that genital schistosomiasis affect fertility in both male and females. Infertility has cultural implications in the African context where child birth is highly cherished. People count their economic viability and power in terms of the number of children they have. Childlessness due to infertility thus becomes a source of mockery and derogation. This condition makes childless couples and individuals to voluntarily withdraw from public life scrutiny. Apart from problems of infertility,

schistosomiasis infection also results in death of spouses, breadwinners, active working populations in communities.

The study further reveal that about 20% of the respondents suffer from cultural effects of infertility due to schistosomiasis while approximately 19% go through the trauma of death as spouses, children, relatives and sole bread winners at home as contained.

In the rural communities of the study area, blood in urine is seen as normal; hence schistosomiasis is not considered a disease. However, cultural believes emerge when the infection becomes widespread leading to spiritual connotations and conjectures. At the chronic stage, schistosomiasis patients are forbidden from partaking in traditional activities and festivities on the river, a common phenomenon in the Dangme district during the annual festivals of the people (Asafotufiame festival). Recreational activities such swimming and boat riding that regatta competitions are organized during festival celebrations, notably, Asafotufiame, Afenorto and Torsigbeza festivals. However, known people suffering from schistosomiasis are prevented from participating in the swimming and regatta competitions; hence they feel as being social outcasts during such recreational activities.

#### **5.4.3 Effects of schistosomiasis on Education of Children**

“Healthy mind, it is well established, lives in a healthy body.” In this vein, people who are infected by the penetration of the cercariae (small worm) the organism termed schistomulum experience deteriorating health conditions. This development invariably does not make them physically fit to attend to all social functions including education without any effects. School children or students suffering from schistomulum have their

schooling or education affected in a number of ways. First of all the children become dull in class and thereby are unable to actively participate in any academic activities. They often sleep in class due to the fact that they become weak and are unable to be agile. These observations were confirmed by the study conducted by McGarvey (2000) who indicated that the disease affects the general liveliness and academic performance of children infected is affected in school. These results are also confirmed by the 2014 USAID report which shows that poor growth and decreased mental development are especially suffered by children as the most side effects of the disease. The disease also leads to undernourishment and interrupts school attendance (USAID, 2014).

Secondly, the school enrolment reduces beyond the needed expectation, a situation which poses a great challenge to the Free Compulsory Universal Basic Education (FCUBE) policy of the government. The reason simply is that once the children are unhealthy their schooling will become a secondary issue and the treatment of the disease rather their priority.

Moreover, academic performance of the school children invariably is also affected because the pain and suffering resulting from the disease keep them away from school to look for treatment for their health condition. School children with the worm infection perform abysmally poorer than their counter parts that do not experience the disease. This reduces the impact of the school feeding program especially in communities close to water bodies where schistosomiasis is prevalent.

Results from the study revealed that the most vulnerable and affected segments (age groups) of the population are the 10-20 years age group and incidentally, the school

going age groups. In the Dangme East District, the two age groups form approximately 82% of the infected people and in the South Tongu, they form 52%. This finding agreed with that of Gordon and Amatekpor (1999) who stated that exposure to infection, is high especially among fishermen who dive to set fishing trap as well as children who draw water, swim, bath and wash in the infected water. The implication is that many children in the area will not be well educated because of these infections.

#### **5.4.4 Impact of schistosomiasis Infection on Health of Patients**

The health experts interviewed revealed that schistosomiasis cause malnutrition, anaemia and growth retardation, and increase susceptibility to other infections. A staff of the South Tongu District Health Management Team stated that: *schistosomiasis has adverse effects on fertility and pregnancy and also reduces workers' productivity.*

Epidemiologically, chronic schistosomiasis reduces the capacity of those infected to work and in some cases can result in death. This view is confirmed by a health worker in the study area: *when children in particular get infected, we notice anaemia and stunting; also because it weakens the child it reduces the ability to learn.* In any case, the effects of the disease on people's health are multifaceted. The cercariae (small worms) after they have successfully entered the host and the presence of the organism (schistosomulum) is observed, the health of the affected individual (affected person) begins to deteriorate. There are several effects of the disease. To begin with, one of the effects of the disease is a feverish condition coupled with headache and chill is what the affected person complains of most of the time. Also, abdominal pains is another major side effect experienced by people infected with the cercariae (small worms) most especially people whose activities are always water related, for instance, people who fish and harvest

oyster from the Volta river and its subsidiaries. Additionally, Diarrhoea and dysentery are also major effects of the disease as the patients observe mucus and blood stains in their stool.

Also, when individuals are affected by the disease they experience anaemic condition due to blood loss stemming from either passing urine with blood frequently or blood stains in their stool. In addition, the people infected with cercariae experience weight lost which is obviously caused by their health conditions and physical deterioration and infected individuals also develop skin rashes especially those whose economic activities make them to dive into the river all day long to harvest oyster.

### **5.5 Suggested Measures of Controlling Schistosomiasis**

Information was also gathered on respondents' views on how schistosomiasis can be controlled (managed). The three main measures suggested were education, provision of safe water and improvement in health facilities and sanitation practices. About 52% of the respondents suggested intensive and extensive health education in the study areas to provide community members adequate knowledge on the schistosomiasis disease and its impact on human life and activities. A strong case was also made for the supply and use of safe sources drinking water and other domestic uses. About 27% of the respondents advocated for provision of water while 13% requested for increased and upgrading of health facilities to cater for their health needs. One of the fisher folks observed that: *if only the government will ensure that domestic water supply is provided for the entire community, we will be free from the disease and its effects; because we drink from the same river we are not able to avoid getting infected.* About 10% of the respondents also suggested that the establishment of factories in the area could help them avoid contact with water and thereby prevent themselves against the disease. One of the respondents

stated that: *because most of what we do to support our families is connected to water it is difficult to avoid the disease. For this reason government should consider alternative livelihood interventions for us.*

Some of the suggestions are in line with intervention measures offered by Meurs (2014) for schistosomiasis eradication such as the delivery of clean water and better sanitation, snail control, and behaviour change. Aspects of these are consistent with the suggestions of Apuusi (2012) that improved water supply and sanitation with health education are the essential approaches to reach viable decreases of these parasite infections. They also coincide with the findings of Steinmann et al. (2006) that improvements in water supply and hygiene can disruption the cycle of transmission through diminished human-water contact and reduced environmental pollution with excreta.

In addition, these suggestions offered by the respondents can be explained within the context of the conceptual framework which provides that the existence of such intervening variables as improved water supply and sanitation with health education can lessen the disease burden.

## **5.6 Chapter Conclusion**

The analysis in this chapter has shown that majority of the people living in the study communities have appreciable knowledge about the causes of this disease. However, they are unable to fully protect themselves against the disease since their daily economic activities expose them to the infections. The disease has serious effects on the population in the study area. Apart from the pains associated with the disease, the high cost of treatment affects the economic status of the patients. The disease also affects the academic activities of children of school going age because any they are ill, they do not

go to school. This further negatively affects the development of human capital and for that matter development in the area. People living in the study area suggested intensive and extensive health education and provision of clean water as measures that can be adopted to reduce the incidence of the disease.

## CHAPTER SIX

### SUMMARY, CONCLUSIONS AND RECOMMENDATIONS

#### 6.1 Introduction

This chapter presents the summary of the main findings and conclusions drawn from all the findings. It concludes with recommendations to policy makers, NGO's, district assemblies, opinion leaders and all stake holders in the water resources sector on the incidence of the of schistosomiasis disease.

The main objective of the study was to examine the spatio-temporal incidence of the trends of occurrence of the disease in the Dangme East and South Tongu Districts in the Greater Accra and Volta Regions respectively. The first objective was to examine the spatial and temporal patterns of the incidence of schistosomiasis in the study areas; the second objective was to identify the environmental factors that promote the prevalence of schistosomiasis in the study areas, the third objective was to evaluate the anthropogenic behavioural factors that underpin the existence of schistosomiasis in both study areas, the forth objective was to examine the knowledge and perceptions of the local people about the schistosomiasis disease in their communities, the fifth objective was to examine the preventive measures and coping strategies adopted by people in the study areas to deal with schistosomiasis. The study further examined the relationships between the spatial-temporal incidence of shistosomiasis and key socio-demographic factors including age, sex, level of education and income level.

## 6.2 Summary of Main Findings

In relation to the first objective of this study, which aimed at examining the spatio-temporal dimensions of the disease, the study shows that there was higher rate of prevalence of schistosomiasis infection among men than women in the two districts. Schistosomiasis cases in the two districts show different trends. Initially, prevalence cases increased steadily in both districts. However, in the Dangme East District, the prevalence rate increased to the maximum of 233 in 2009 and dropped to a minimum of 12 cases in 2011 as a result of an extensive and intensive education drive in the districts by the District Health Directorate. The decline was attributed to massive educational campaigns in the area. These results indicate that effective education and awareness creation of the disease can positively reduce prevalence rates in schistosomiasis endemic areas.

In contrast to the favourable situation of declining incidence witnessed in the Dangme East District, Schistosomiasis incidence in the South Tongu District shows increasing trend for the four consecutive years of study from 95 in 2008 to 128 in 2009, 167 in 2010 (an increase of 30.5%) and finally 189 in 2011. This steady increase in cases of schistosomiasis in the South Tongu District could be attributed to lack of intensive health education and extensive use and dependence on the Volta River by the various riparian communities in the district for different economic activities.

Information obtained shows that males were more susceptible to schistosomiasis infection than females. The in-depth interviews revealed that one reason why men are more infected than women is the fact that men predominantly make use of the river for

various socio economic activities such as fishing, clam and shrimps harvesting, boat transportation services and swimming and diving in the water.

On the second objective of examining the environmental factors that promote the prevalence of schistosomiasis in the study areas, the study revealed that the high incidence of the disease in the study districts were attributed to environmental conditions as well as developmental projects. The South Tongu and Dangme East Districts are both located in the Lower Volta Basin, south of the Akosombo and Kpong dams. The creation of the Akosombo dam created the environment for this disease. Construction of the dams upstream resulted in several changes in the Volta River's flow regime. The dams drastically reduced the volume of water in the river downstream. The river's speed and mechanical processes were also reduced. The resultant relatively shallow river with stagnated flow, together with the creation of several shallow streams, ponds and lakes facilitated development of marshy vegetation along and across the water bodies. The vegetation provides favourable nutrients and shades for the snail hosts. The environmental and developmental factors combined and collectively created favourable condition (habitat) for the development, survival, multiplication, flourishing and widespread of the vector host snails and the infectious cercariae.

On the third objective of identifying the attitudinal factors which contribute to the high incidence of the disease, the study revealed that people come into contact with water bodies through its use for recreational activities or as part of their domestic chores, such as washing, cleaning items and also bathing in the available water resources. These activities constantly, and for reasonable periods of time, keep patrons in contact with the infected water to increase the prevalence rate. As a matter of fact, the study revealed that

majority of respondents came into contact with these water bodies between 1-6 times a week which further increases the risk of getting the disease.

The results further revealed that there exist a significant relationship between age and the treatment method of schistosomiasis as younger people tend to visit hospitals for treatment while older people tend to use traditional or herbal medicine. Educational level was also found to have a significant relationship with the treatment method of the disease as more educated people used orthodox treatment methods by going to hospitals while less educated people were more interested in traditional methods of treatment. The treatment method did not have association with sex or gender as males and females did not behave differently when it comes to the treatment of schistosomiasis. The income level of respondents was also found to have a significant relationship with the treatment method as those with higher levels of incomes seek orthodox treatment methods while those with smaller incomes patronize traditional methods of treatment. These findings suggest that poverty is a barrier to seeking effective treatment.

Furthermore, evidence from the study show that most locations or communities of the study area are of rural settings with inadequate supply of potable water and sanitation facilities. With the inadequate sanitary toilets in the area, people defecate in the open. Their faeces together with that of livestock and other domestic animals are washed into the water bodies to increase their infected and infectious potential. The faeces also provide nutrients for both vegetation and host snails to feed on and flourish. The economic activities of fishing clam harvesting, trading and farming constantly and for long-periods keep people in contact with water and for long periods enough facilitate infections through penetration of the skin of people by the cercariae to infect them.

On the fourth objective of examining the knowledge and perceptions about the disease, the study revealed that most of the local people knew the symptoms of the disease. The most known symptom identified by local people is blood in the urine. Most of the respondents also knew the causes of the disease. Only a few of them attributed the cause of this to spiritual factors. This high level of knowledge about the disease is attributed to intensive education about it. Apart from the health effects of this disease, respondents explained that the disease affected them economically as they are required to spend huge sums of money on treatment. The study specifically revealed that there is a significant relationship between age, educational level and perception of how the disease is contracted and that older people are more informed about how the disease is contracted than younger people. Additionally, educated people are more informed than less or non-educated when it comes to how the disease is contracted. Sex or gender however did not have any association with how the disease is contracted.

Additionally, on the knowledge of the organism that causes schistosomiasis, the study revealed a significant relationship between knowledge of the organism that causes the disease and educational level but no relationship existed between knowledge of the organism that causes the disease and age and sex. The study further revealed that, there exist a significant relationship between age and the perception of the disease but no relationship exists between the perception of the disease and educational level and sex.

Finally, on the fifth and last objective of examining the preventive measures and coping strategies adopted by people in the study areas to deal with schistosomiasis, the study revealed that prevention and control of schistosomiasis in the study communities could effectively be tackled through snail control, improved sanitation and health education.

Both prevention and control depend on an area specific, species specific and epidemiologically specific, a mixture of intervention methods. The characteristics of endemic areas, transmission pattern, the infecting parasite species and strains, the intermediate snail host(s) and the behavioural customs of the human communities and their socioeconomic backgrounds all contribute to multiplicity of interactions to produce a vast mosaic of transmission and epidemiological pictures. Respondents adopted a variety of measures and strategies to cope and manage infections and effects of schistosomiasis. These include hospital attendance, boiling of water, and avoidance of contaminated water bodies as well as water purifiers. Other forms of coping processes adopted were consultation of traditionalists and use of herbal products together with shrine and spiritual assistance.

The research participants mentioned of several measures that government agencies could adopt to control the spread of the disease in their area. These include education and improvement in health facilities and sanitation practices. A strong case was also made for the supply and use of safe drinking water sources and other domestic uses. The findings of the study is consistent with the findings of Collier et al., (1998), who concluded that prevention and control of schistosomiasis are based on preventive treatment, snail control, improved sanitation and health education.

### **6.3 Conclusions**

It is concluded the schistosomiasis is still a serious public health problem, especially in the South Tongu district. Its high prevalence in the study areas is attributed to the creation of large dams. These findings support the argument by some researchers that in most cases large scale dams are often associated with different health problems

(Thabane, 2000; Aguirre, 2005). According to WHO (1997), the provision of safe water supply for drinking and washing of clothes is the most cost effective measures of control in the most endemic areas. Also, the provision of pipes or dug out wells and bore holes encourage the avoidance of contact with infected water where the appropriate intermediate snails may be found.

Whereas some studies tend to suggest that women are at more risk of suffering from this disease, men in the study area were found to be rather more likely to be affected by the disease than females. This is due to their economic activities as fishermen which expose them to contaminated water. These findings support the claim elsewhere that Schistosomiasis is an occupational hazard in endemic areas of many developing countries where mostly fishermen and paddy rice farmers come into contact with slow running shallow waters (Doumenge et al 1987; Jordan and Webbs, 1993). The findings give credence to Meade's model which was used for this study (see Chapter 2). Indeed, disease prevalence in the study area is influenced by the interaction of environmental factors and behavioural factors.

#### **6.4 Recommendations**

Firstly, good health of the people could be guaranteed by making water supply available and in sufficient quantities for domestic use. This domestic use of water include, cooking, hand –washing, personal bathing, cleaning and laundering clothes. Moreover, it must be accessible by all the communities without the need to carry containers of water over long distances or having to visit sites where the disease is prevalent. Further, water must be made available all the time or when it is needed at an affordable cost. Water must meet local standards for taste, odour and appearance. Contact sites for water should

be kept clean and hygienic through various means including communal services to make the site devoid of twigs, water weeds such as water hyacinth and lilies, and snails favourable for the schistosomiasis infection. This suggestion should be co-ordinated by all stakeholders including the local chiefs, opinion leaders, the fisher-folks themselves and the Assemblymen and women in the study areas.

Secondly, the study recommends that the District Assemblies and other stakeholders in the two districts should provide sanitary facilities in the study areas to improve the sanitary conditions in the affected communities. Government should further as a matter of urgency improve the welfare of the riparian dwellers. Further, adequate strategies should be put in place to manage waste in order to facilitate the reduction in the transmission of schistosomiasis in the study districts.

Further, regular or periodic screening and treatment should be carried out in the study area for all ages by the health institutions in collaboration with non-governmental organizations (NGOs) working in the two districts.

A very good programme and intensive education will be required to reduce the incidence of the disease. There is the need to educate the communities on how to handle and locally treat water for domestic use through sustainable educational programmes to help eradicate the disease. Follow-up surveys should be conducted regularly to monitor the effectiveness of strategic implementation measures on personal hygiene, sanitation and general health improvement to put in place the control of schistosomiasis.

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## APPENDIX A

### DEPARTMENT OF GEORGRAPHY AND RESOURCE DEVELOPMENT

#### UNIVERSITY OF GHANA

#### Research Questionnaire for the Household of the Head/Representative in Study

##### Areas

I am a Master of Philosophy student of the University of Ghana, Legon, and will be very pleased if you could kindly spend some time to answer this questionnaire, which seeks to collect data as part of a research on the topic “A Spatio-Temporal Analysis of the Incidence of Schistosomiasis (Bilharzia) in the Dangme East and the South Tongu Districts in the Lower Volta Basin” . The research is a partial fulfillment of the requirements of the award of a Master of Philosophy degree in Geography and Resource Development from the University. This research is solely for academic purpose and you are assured that all answers provided will be treated with intense confidentiality.

#### Section “A”

##### Background Information

- District: .....
- Sex: .....
- Age: .....
- Town/Village: .....
- Ethnicity: (Tick) Ewe [ ] Dangme [ ] Ga [ ] Akan [ ] Others. ....
- Educational level (The highest completed level)
  - a. Tertiary [ ]
  - b. Senior secondary/Vocational [ ]
  - c. Elementary (Primary and J.H.S) [ ]
  - d. No formal education [ ]
- Occupation or main source of Income:
  - Formal – Salaried worker [ ] (Specify).....

In-formal (Tick)

- a. Farming [ ]
- b. Fishing [ ]
- c. Trading [ ]
- d. Construction work [ ]
- e. Local Crafts [ ]

### **SCHISTOSOMIASIS (BILHARZIA)- RELATED INFORMATION**

1. Have you ever suffered from bilharzia (Schistosomiasis)? Yes [ ] No [ ]
2. If yes, how many times?
  - a. Once
  - b. Twice
  - c. Three times or more
  - d. Never
3. When was the last time you received treatment?
  - a. Up to 1 year ago [ ]
  - b. Up to 2 years ago [ ]
  - c. Up to 3 years ago [ ]
  - d. More than 3 years ago [ ]
4. What did you do about it?
  - a. I visited a hospital/health centre [ ]
  - b. I used a herbal medicine [ ]
  - c. I (my parents) bought medicine from the drug store [ ]
  - d. I did not do anything about it [ ]
5. Who administer the treatment and where?
  - a. Hospital/Health Centre Dispensary Staff [ ]
  - b. Medicine bought and administer druggist [ ]
  - c. Self-medication [ ]

- d. Herbalist [ ]
- e. Spiritualist [ ]
6. Do you often come into contact with water bodies (e.g. river, stream, and pond) in your day-to-day activities?
- a. Daily [ ]
- b. 1 to 3 times per week [ ]
- c. 4 to 6 times per week [ ]
- d. Once a month [ ]
- e. Once a year [ ]
7. What activities/reasons bring you into contact with the water body?  
(Multiple answers are possible)
- a. Fetching water to farm or for household chores [ ]
- b. Walking through the water to go to the farm [ ]
- c. Washing (your hand, legs, utensils, clothes etc.) [ ]
- d. Swimming, playing “ water games” with friends [ ]
- e. Fishing/Oyster harvesting [ ]
- f. Crossing in the canoe to other communities/villages [ ]
- g. Winning of sand from the river/streams [ ]
8. In your opinion which factors contribute to the high incidence of bilharzia in your community? (Multiple answers are possible)
- a. Presence of contaminated water bodies [ ]
- b. Punishment from the gods (Spiritual) [ ]
- c. Poverty [ ]
- d. Ignorance of the disease [ ]
- e. Inadequate education on the disease [ ]

- f. Illiteracy [ ]
- g. Absence of health facilities [ ]
- h. Others, please specify. ....

## **SOCIO - ECONOMIC STATUS OF RESPONDENTS**

### **INCOME AND WEALTH STATUS**

9. Specified type of occupation
- a. Salaried Worker [ ]
  - b. Farming [ ]
  - c. Fishing [ ]
  - d. Local craft making [ ]
  - e. Self-employed [ ]
  - f. Unemployed [ ]
  - g. Others (please specify).....
10. Range of income per month?
- a. Below GHC 50 [ ]
  - b. GHC 50-150 [ ]
  - c. Above GHC 150-300 [ ]
  - d. Above GHC 300 [ ]
11. What is your main source of income?
- a. Proceeds from farm produce [ ]
  - b. Fishing in the river [ ]
  - c. Mat weaving [ ]
  - d. Collection and selling of shell fish [ ]
  - e. Trading activities [ ]
  - f. Salaried Worker [ ]
  - g. Other (please specify).....

12. What is your primary source of water for use in the house?

- a. Pipe [ ]
- b. Well [ ]
- c. River [ ]
- d. Stream [ ]
- e. Pond/pool [ ]
- f. Others.....

### GENERAL KNOWLEDGE ON BILHARZIA PREVALENCE

(Tick where applicable)

13. Locally, how does one know that he or she has bilharzia (symptoms)?

- a. Difficulty in urinating [ ]
- b. Blood in urine [ ]
- c. Blood in faeces/stool [ ]
- d. Vomiting of blood [ ]
- e. Abdominal pain [ ]

14. In your own opinion, what is the most common disease in your community?

- a. Malaria [ ]
- b. Diarrhoea [ ]
- c. Schistosomiasis [ ]
- d. HIV/AIDS [ ]
- e. Others (specify) .....

15. How is Schistosomiasis (bilharzia) contracted?

- a. Through contact with contaminated water bodies [ ]
- b. By drinking and bathing of contaminated water [ ]
- c. By breathing infected air [ ]
- d. By eating contaminated fish [ ]

16. Which organism is responsible for the transmission of Schistosomiasis (bilharzia)?

- a. Water snails [ ]
- b. Water flies [ ]
- c. Fishes [ ]
- d. Oysters [ ]
- e. Lobsters [ ]

17. Schistosomiasis (bilharzia) can result in which of the following?

- a. Death [ ]
- b. Paralysis [ ]
- c. Cancer [ ]
- d. Infertility [ ]

**SCHISTOSOMIASIS (BILHARZIA) COPING STRATEGIES AND THEIR EFFECTIVENESS IN THE STUDY AREAS**

18. How do you prevent yourself from getting bilharzia?

- a. Attendance at hospital [ ]
- b. Boiling water before use [ ]
- c. Avoiding contaminated water [ ]
- d. Using water purifiers. [ ]

19. Do you get infected with bilharzia after adopting a particular preventive measure?

- a. Yea [ ]
- b. No [ ]

20. What influences your choice of the Schistosomiasis (bilharzia) prevention method?

- a. Available income [ ]
- b. Recommendations by peers and relatives [ ]
- c. Health education [ ]
- d. Parental advice [ ]
- e. Others (specify) .....

21. Why do you take any of the above measures and when do you observe the next bilharzia occurrence

.....

22. Which type of health centre/hospital do you visit? (Multiple answers applicable).

a. Government [ ]

b. Private [ ]

c. Traditionalist [ ]

d. Shrine/Spiritualist [ ]

e. Others, please specify. ....

23 Have you ever been detained on admission at a health facility due to bilharzia?

a. Yes [ ]

b. No [ ]

24 What are the various preventive measures against bilharzia in your community?

a. ....

b. ....

c. ....

d. ....

### **SOCIO-ECONOMIC EFFECT OF BILHARZIA IN THE STUDY AREAS**

25. How much do you spend on bilharzia prevention? .....

26. How much do spend on treatment at home?

a. GHC 1-4 [ ]

b. GHC 5-10 [ ]

c. Above GHC 10 [ ]

d. No cost [ ]

27. How much do you pay anytime you visit a hospital due to bilharzia without NHIS card?

a. GHC 1-5 [ ]

b. GHC 6-10 [ ]

c. GHC 11-15 [ ]

d. Above GHC 16 [ ]

28. Does bilharzia have any effect on your economic activities?

a. Yes [ ] b. No [ ]

29. If yes, specify .....

30. What will you suggest to decision makers to help control bilharzia in your community? .....

THANK YOU VERY MUCH

**APPENDIX B: Chi-Square Tests****B1: Chi-Square Tests between Age and the experience of bilharzia**

	Value	Df	Asymp. Sig. (2-sided)
Pearson Chi-Square	.935	3	.817
Likelihood Ratio	.936	3	.817
Linear-by-Linear Association	.579	1	.447
N of Valid Cases	320		

Source: Field Data, 2012.

**B2: Chi-Square Tests between Sex and the experience of bilharzia**

	Value	Df	Asymp. Sig. (2-sided)
Pearson Chi-Square	8.460	1	.004
Continuity Correction	7.803	1	.005
Likelihood Ratio	8.523	1	.004
Fisher's Exact Test			
Linear-by-Linear Association	8.434	1	.004
No. of Valid Cases	320		

**B3: Chi-Square Tests between Educational level and the experience of bilharzia**

	Value	Df	Asymp. Sig. (2-sided)
Pearson Chi-Square	4.510	3	.211
Likelihood Ratio	5.210	3	.157
Linear-by-Linear Association	.368	1	.544
N of Valid Cases	320		

Source: Field Data, 2012.

**B4: Chi-Square Tests between Age and how bilharzia is contacted**

	Value	Df	Asymp. Sig. (2-sided)
Pearson Chi-Square	32.443	9	.000
Likelihood Ratio	32.768	9	.000
Linear-by-Linear Association	1.465	1	.226
N of Valid Cases	320		

Source: Field Data, 2012.

**B5: Chi-Square Tests between Sex and how bilharzia is contacted**

	Value	Df	Asymp. Sig. (2-sided)
Pearson Chi-Square	1.744	3	.627
Likelihood Ratio	1.746	3	.627
Linear-by-Linear Association	.736	1	.391
N of Valid Cases	320		

Source: Field Data, 2012.

**B6: Chi-Square Tests between Educational level and how bilharzia is contacted**

	Value	Df	Asymp. Sig. (2-sided)
Pearson Chi-Square	24.555 <sup>a</sup>	9	.004
Likelihood Ratio	28.085	9	.001
Linear-by-Linear Association	.051	1	.822
N of Valid Cases	320		

Source: Field Data, 2012.

**B7: Age and knowledge of the organism that causes bilharzia**

			Age	Organism responsible for the transmission of bilharzia
Spearman's rho	Age	Correlation Coefficient	1.000	-.072
		Sig. (2-tailed)	.	.201
		N	320	320
	Organism responsible for the transmission of bilharzia	Correlation Coefficient	-.072	1.000
		Sig. (2-tailed)	.201	.
		N	320	320

Source: Field Data, 2012.

**B8: Sex and knowledge of the organism that causes bilharzia**

			Sex	Organism responsible for the transmission of bilharzia
Spearman's rho	Sex	Correlation Coefficient	1.000	.086
		Sig. (2-tailed)	.	.124
		N	321	320
	Organism responsible for the transmission of bilharzia	Correlation Coefficient	.086	1.000
		Sig. (2-tailed)	.124	.
		N	320	320

Source: Field Data, 2012.

**B9: Educational level and knowledge of the organism that causes bilharzia**

			Educational level	Organism responsible for the transmission of bilharzia
Spearman's rho	Educational level	Correlation Coefficient	1.000	.176 <sup>**</sup>
		Sig. (2-tailed)	.	.002
		N	321	319
	Organism responsible for the transmission of bilharzia	Correlation Coefficient	.176 <sup>**</sup>	1.000
		Sig. (2-tailed)	.002	.
		N	320	320

Source: Field Data, 2012.

**B10: Age and factors that contribute to the high incidence of bilharzia**

			What is your age?	Factors contributing to the high incidence of bilharzia
Spearman's rho	What is your age?	Correlation Coefficient	1.000	.218 <sup>**</sup>
		Sig. (2-tailed)	.	.000
		N	320	320
	Factors contributing to the high incidence of bilharzia	Correlation Coefficient	.218 <sup>**</sup>	1.000
		Sig. (2-tailed)	.000	.
		N	320	320

Source: Field Data, 2012.

**B11: Sex and factors that contribute to the high incidence of bilharzia**

			What is your sex?	Factors contributing to the high incidence of bilharzia
Spearman's rho	What is your sex?	Correlation Coefficient	1.000	.062
		Sig. (2-tailed)	.	.268
		N	321	319
	Factors contributing to the high incidence of bilharzia	Correlation Coefficient	.062	1.000
		Sig. (2-tailed)	.268	.
		N	320	320

Source: Field Data, 2012.

**B12: Educational level and factors that contribute to the high incidence of bilharzia**

			Factors contributing to the high incidence of bilharzia	Educational level
Spearman's rho	Factors contributing to the high incidence of bilharzia	Correlation Coefficient	1.000	.031
		Sig. (2-tailed)	.	.584
		N	319	318
	Educational level	Correlation Coefficient	.031	1.000
		Sig. (2-tailed)	.584	.
		N	318	321

Source: Field Data, 2012.

**B13: Age and Method of Prevention**

			How do you prevent contracting bilharzia	Age
Spearman's rho	How do you prevent contracting bilharzia	Correlation Coefficient	1.000	.197 <sup>**</sup>
		Sig. (2-tailed)	.	.000
		N	320	320
	Age	Correlation Coefficient	.197 <sup>**</sup>	1.000
		Sig. (2-tailed)	.000	.
		N	320	320

Source: Field Data, 2012.

**B14: Sex and Method of Prevention**

			How do you prevent contracting bilharzia	Sex
Spearman's rho	How do you prevent contracting bilharzia	Correlation Coefficient	1.000	.142 <sup>*</sup>
		Sig. (2-tailed)	.	.011
		N	320	320
	Sex	Correlation Coefficient	.142 <sup>*</sup>	1.000
		Sig. (2-tailed)	.011	.
		N	320	320

Source: Field Data, 2012.

**B15: Educational Level and Method of Prevention**

			How do you prevent contracting bilharzia	Educational level
Spearman's rho	How do you prevent contracting bilharzia	Correlation Coefficient	1.000	.069
		Sig. (2-tailed)	.	.222
		N	320	319
	Educational level	Correlation Coefficient	.069	1.000
		Sig. (2-tailed)	.222	.
		N	320	320

Source: Field Data, 2012.

**B16: Age and type of health facility visited**

			Type of health facility visited	Age
Spearman's rho	Type of health facility visited	Correlation Coefficient	1.000	.020
		Sig. (2-tailed)	.	.721
		N	320	320
	Age	Correlation Coefficient	.020	1.000
		Sig. (2-tailed)	.721	.
		N	320	320

Source: Field Data, 2012.

**B17: Sex and type of health facility visited**

			Type of health facility visited	Sex
Spearman's rho	Type of health facility visited	Correlation Coefficient	1.000	-.116*
		Sig. (2-tailed)	.	.038
		N	320	320
	Sex	Correlation Coefficient	-.116*	1.000
		Sig. (2-tailed)	.038	.
		N	320	320

Source: Field Data, 2012.

**B18: Educational level and type of health facility visited**

			Type of health facility visited	Educational level
Spearman's rho	Type of health facility visited	Correlation Coefficient	1.000	-.030
		Sig. (2-tailed)	.	.590
		N	320	319
	Educational level	Correlation Coefficient	-.030	1.000
		Sig. (2-tailed)	.590	.
		N	319	321

Source: Field Data, 2012.

## APPENDIX C

Table showing documented cases of schistosomiasis of the various health facilities.

FI D	UnitId	UnitT ype	UnitTy peNa	Regio n	CO DE	NAME	COD E_1	NAME _1	Schis_ 2009	Schis_ 2010	Schis_ 2011	Schis_ 2012	Schis_ 2013	Schis_ 2014	Schi_ Total
0	GHH00 737	1	Hospita l and Teachin g Hospita l	GHP 005	737	Dangme East District Hospital	51	Dangm e East	31	15	26	5	5	13	95
1	GHH00 682	2	Health Centre	GHP 005	682	Sege Health Centre	51	Dangm e East	35	9	0	0	0	0	44
2	GHH00 683	2	Health Centre	GHP 005	683	Kasseh Health Centre	51	Dangm e East	156	4	7	4	2	3	176
3	GHH00 738	2	Health Centre	GHP 005	738	Ada Health Centre	51	Dangm e East	6	1	0	0	2	0	9
4	GHH00 739	2	Health Centre	GHP 005	739	Pediator Kope Health Centre	51	Dangm e East	0	0	1	0	0	0	1
5	GHH00 741	2	Health Centre	GHP 005	741	Borniko pe Health Centre	51	Dangm e East	0	0	0	0	0	0	0
6	GHH01 743	2	Health Centre	GHP 009	174 3	Kpotam e Health Centre/ CHPS	51	Dangm e East	2	3	3	17	4	7	36

7	GHH0 1735	2	Health Centre	GHP 009	173 5	Gamen u Health Centre	51	Dang me East	0	0	0	0	0	0	0
8	GHH0 1746	2	Health Centre	GHP 009	174 6	Dordoe kope Health Centre	51	Dang me East	0	1	0	0	0	0	1
9	GHH0 0740	3	Clinic	GHP 005	740	Anyam am Clinic	51	Dang me East	5	0	0	0	2	1	8
1 0	GHH0 1748	1	Hospit al and Teachi ng Hospit al	GHP 009	174 8	Sogako pe District Hospita l	115	South Tongu	73	63	20	4	4	5	169
1 1	GHH0 1745	2	Health Centre	GHP 009	174 5	Adutor Health Centre	115	South Tongu	7	10	7	6	2	5	37
1 2	GHH0 1744	2	Health Centre	GHP 009	174 4	Tefle Health Centre	115	South Tongu	0	0	0	0	0	0	0
1 3	GHH0 1739	2	Health Centre	GHP 009	173 9	Dabala Health Centre	115	South Tongu	18	6	4	2	2	0	32
1 4	GHH0 1738	2	Health Centre	GHP 009	173 8	Agorta Health Centre	115	South Tongu	0	0	0	0	0	0	0
1 5	GHH0 1737	2	Health Centre	GHP 009	173 7	Asidow ui Health Centre	115	South Tongu	0	0	0	0	0	0	0

16	GHH01736	2	Health Centre	GHP009	1736	Agbakope Health Centre	115	South Tongu	0	0	0	0	0	0	0
17	GHH01742	3	Clinic	GHP009	1742	Fame Clinic	115	South Tongu	0	2	3	0	0	0	5
18	GHH01741	3	Clinic	GHP009	1741	Sogakope RCH	115	South Tongu	0	0	0	0	0	0	0
19	GHH01734	3	Clinic	GHP009	1734	Combo ni Polyclinic	115	South Tongu	28	82	42	22	13	1	188
20	GHH01747	4	CHPS	GHP009	1747	Dorkplorme CHPS	115	South Tongu	0	0	0	0	0	0	0
21	GHH01740	5	Maternity Home	GHP009	1740	Good Shepherd Maternity Home	115	South Tongu	0	0	0	0	0	0	0
								Total	361	196	113	60	36	35	801
								Percentage (%)	45.1	24.5	14.1	7.5	4.5	4.3	100

## APPENDIX D

### INTERVIEW GUIDE FOR PEOPLE LIVING IN THE STUDY AREA

#### PART 1: BACKGROUND INFORMATION

- i. Name of Study Area(s):.....
- ii. Date of Interview:.....
- iii. Sex:.....
- iv. Occupation:.....
- v. Number of years living in the community:.....

#### PART 2: KNOWLEDGE ABOUT SCHISTOSOMIASIS

- i. Have you ever heard of or experienced Schistosomiasis?
- ii. How long have you suffered from it?
- iii. How did you treat?
- iv. In your opinion, what do you think was the cause of the diseases/infections?
- v. How long have you lived in this community
- vi. Have you ever been affected by the disease?
- vii. Do you have an idea why this disease is common in the area?
- viii. Did you know of the ailment when you first contracted the disease?
- ix. How did you find out it was a waterborne disease?
- x. You mentioned the symptoms as difficult in urinating, blood in urine and faeces vomiting and abdominal pains.
- xi. Apart from the usual symptoms what effect does the disease have on your physique?

#### PART 3: PERCEPTION ABOUT SCHISTOSOMIASIS AND MITIGATION

##### MEASURES

- i. What do you think is the perception of people about schistomiasis?
- ii. What are some of the things people attribute the disease to?

- iii. What do you normally do when infected by the disease?
- iv. Did the use of self medicine lessen the pain of it?
- v. What other measures do people use to treat the disease?
- vi. Some of you claim to use self medication. Why do you prefer that instead of going to the hospital?
- vii. What do you think you have to do to prevent contracting the disease?
- viii. Are there any specific times in the year that the disease is prevalent?

#### PART 4: SOCIO-ECONOMIC IMPACT OF SCHISTOSOMIASIS

- 1. What are the effects of the disease in your community?
- 2. What do you think the government should do to help lessen the disease and its effects or eradicate the disease altogether?
- 3. Have your opinion leaders discussed this problem with the government and health officials.
- 4. Some of you are fishermen and others do other jobs like mat weaving and pot making. Does that mean those who are not fishermen would not contract the disease?
- 5. Since they also fetch water from the river to drink and they bath in the river what do you think should be done to avoid direct contact with the water from the river?
- 6. Would you say a lot of children are prone to getting the disease much more than adults for that matter their love of water to have fun is a source of worry?

Thank you.