AN ANALYSIS OF THE GUINEA WORM ERADICATION PROGRAMME AND ITS EFFECTS ON SOCIAL AND ECONOMIC DEVELOPMENT IN THE NORTHERN REGION OF GHANA

BY

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DEDICATION

THIS THESIS IS DEDICATED TO MY FATHER, DR. NICHOLLAS NYABAH YEMBILAH AND MOTHER, MRS. STELLE KATE YEMBILAH (NEE GURIBIE) FOR THEIR UNFAILING SUPPORT THEY HAVE ALWAYS GIVEN TO MY SISTERS AND I IN OUR EFFORTS TO BE USEFUL TO OURSELVES, OUR FAMILY, OUR COUNTRY, AND HUMANITY

DECLARATION

I hereby declare that except for references cited which have been duely acknowledged, this work is the result of my own research produced under supervision. It has never been presented anywhere, either in part, or wholly, for the award of any degree.

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* An Omen/monstrum for Da-oni & Co

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However, I am responsible for whatever mistakes that may be associated with this thesis.

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LIST OF ACRONYMS

Centre for Disease Control ……....CDC

Community Water and Sanitation Agency ……...CWSA

Ghana Health Service ……GHS

Ghana Statistical Service ……....GSS

Guinea Worm Disease ……...GWD

Guinea Worm Eradication Programme ……GWEP

Onchocerciasis Control Programme in West Africa ……..…..OCP

Primary Health Care ……...PHC

World Health Assembly ……....WHA

World Health Organization ……..WHO

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ABSTRACT

Guinea Worm Disease (GWD) was officially reported in Ghana in 1965. As a result of the global campaign to eradicate the disease in the mid 1980s, Ghana investigated the magnitude of the disease on a pilot basis in the Northern Region. When it was established that the disease was a major public health problem in the country, Ghana started a local initiative towards eradicating the disease in 1986. Global assistance was extended to Ghana in its effort to eradicate the disease which was identified as the Ghana Guinea Worm Eradication Programme in 1989. From 1989 to 2011 the GWEP actively engaged in activities which were aimed at eradicating the disease. The programme recorded zero cases of guinea worm infections in 2011. The research examined the effectiveness of the programme in eradicating the disease and determine its effects on health and socioeconomic development.

The main objective for the research was to determine the effects of the programme on health and socioeconomic development. The factors responsible for the eradication of the disease were tested with respect to the following null and alternate hypotheses:

i. H^o – Increase in the provision of potable water did not cause a significant decrease in the number of cases of guinea worm infections; and
ii. H^1 – Increase in the provision of potable water caused a significant decrease in the number of cases of guinea worm infections.

The conceptual framework for the research was a hybrid framework of disease diffusion and disease ecology in which a disease survives locally in a community and spreads over wider geographic space. Primary data was obtained through the administration of two major sets of questionnaire. The first set was administered to household heads/residents, opinion leaders, and the second set administered to test the hypothesis. The data gathered was analyzed at the regional, the district, and ethnic levels of intervention.

It was found that geological factors, cultural influences and environmental factors were responsible for the local survival and spread of the disease, immobilizing people and affecting productivity. The factor which was considered more responsible for the reduction in the number of guinea worm cases was intervention measures of the programme. The research found the programme positively affected health and socio-economic development by improving economic wellbeing, social wellbeing, and changed people's behaviour towards the disease.

The research looked into the future of the programme and proposed a second phase of the programme to consolidate the programme's success of eradicating the disease. It is recommended that there should be continuity of the activities of the GWEP to ensure that educational and social safety nets which contributed to the programmes success are not allowed to collapse.

The implication these recommendations on policy is that it could lead to an explosion in the acquisition of scientific knowledge and technological innovations in our rural areas, and increase the market share of the manufacturing and commercial sectors of the economy of Ghana.

CHAPTER ONE

GENERAL INTRODUCTION AND PROBLEM STATEMENT

1.1 Introduction

The main purpose of this study is to examine the effectiveness of the Guinea Worm Eradication Programme (GWEP) in eradicating Guinea Worm Disease (GWD) and the effect the programme has had on socio-economic development in the Northern Region of Ghana. GWD was reported in Ghana in 1965 (Bugri, 1993, 1981; Belcher et al, 1975; Waddy, 1956). As a result of the initiation of the global campaign to eradicate the disease in the 1980s (Hopkins, 1987, 1984, 1983; CDC, 1986), Ghana investigated the problem on a pilot basis in the Northern Region in 1987 and found 18 398 confirmed cases of guinea worm infections (Bugri, 1993; CDC, 1988, 1987). The outcome of the 1987 Northern Region search for guinea worm infections served as the basis for a national search for cases to be conducted throughout the country to determine the extent to which the disease existed in the country (CDC, 1989; Ghana/GWEP, 1989). The search revealed 179 843 cases of the guinea worm were found in 6515 villages in the country (Diamenu and Nyaku, 1998). This buildup of information on the severity of the epidemic in Ghana set the stage for the Government of Ghana to secure international assistance from: UN agencies (UNDP, UNICEF), US Aid Agencies (USAID, US Peace Corps), Global 2000, Inc. of the Carter Presidential Centre, financial institutions – Bank of Credit and Commerce International (BCCI), and, religious organizations (Christian Chamber of Commerce, ADRA), etc, to launch a national campaign against the disease (CDC, 1989). These efforts to eradicate GWD which became operational in 1989 was identified as the Ghana Guinea Worm Eradication Programme (Ghana/GWEP) (Diamenu and Nyaku, 1998; Cairncross et al, 2002).

1.2 Problem Statement

Confronted with an outbreak of a guinea worm epidemic in Ghana the Government of Ghana in collaboration with: World Health Organization (WHO), Global 2000 of the Carter

Presidential Centre, and Bank of Credit and Commerce International (BCCI) began adopting measures between 1987 and 1988 to treat existing cases of guinea worm infections in Ghana (CDC, 1987-1988; Diamenu and Nyaku, 1998; Bugri, 1993; WHO, 1994).

Intervention measures taken to arrest the situation were: filtering and treating suspected sources of contaminated drinking water; health education; providing filters to affected communities; Supervising the application of Abate chemicals to infested sources of drinking water; training health personnel for worm extraction; training village volunteers to manage cases and report them at the community level; and preventing guinea worm patients from contaminating surface sources of drinking water (Diamenu and Nyaku, 1998; Chippaux, 1991; Bugri, 1993; Issakah-Tinorgah et al, 1994; Magnussen et al, 1994; Muller, 1976, 1979).

As at 1989, the Northern Region had the highest prevalence rate (56.5%) of guinea worm infections as compared with the rest of the country (43.5%) (Ghana Health Service/GWEP, 2012). The factors which accounted for the Northern Region having the highest prevalence rate of the disease was that areas in which the disease was endemic have low water tables (Agyekum, 2004). This made the search for ground water very difficult. The inhabitants of these areas therefore found it convenient to resort to surface sources of water supply to get water for domestic purposes (Bugri, 1981). Being the region with the highest prevalence rate of guinea worm infections, the Northern Region was given particular attention with respect to eradicating the disease. Between 1989 and 2010 the Ghana/GWEP was able to reduce the high prevalence rate of guinea worm infections to zero (Bugri, 1993; Ghana GWEP National Case Search Summary, 1989; GHS/GWEP, 2012).

Owing to an outbreak of an ethnic conflict in the Northern Region in 2001 the number of reported cases in the region increased by 11% and 22% between January and June and October and December 2001 respectively (CDC, 2002). The situation degenerated further in 2002 when the Zabzugu-Tatale and Tamale districts reported significant increases in the number of cases of guinea worm infections by 16% and 10% of the national total respectively (CDC, 2002). As a result of these reversals in reducing the number of cases of guinea worm in the region the Government of Ghana mobilized more manpower: over 4,000 members of Ghana Red Cross Society's Mothers Clubs in villages in the six highest endemic districts, 5 technical assistants provided by The Carter Center, and four full-time Peace Corps Volunteers to assist stem the tide of the increasing number of cases of guinea worm infections in the region (CDC, 2002).

Also ethnic fighting in the highest endemic area — the eastern part of the Northern region — disrupted health efforts. A 2005-2006 breakdown in the main water supply caused a large outbreak in the town of Savelugu in the district of Savelugu-Nanton in 2006-2007 (CDC, 2007). Despite these set backs the programme was eventually able to break the chain of transmission of the disease to humans in 2010.

After reviewing existing literature on the disease it was realized that much research has been conducted on biology and treatment of the disease (Moorthy and Sweet, 1938; Onamabiro, 1956; Markell and Vogel, 1965; Muller, 1982; Adamson, 1988; Nwoke, 1992; Issaka-Tinorgah, 1994; Magnuseen et al, 1994; Cairncross et al, 2002).

Othe studies have also examined the socio-economic impact of the disease on affected communities (Wurapa et al, 1975; Belcher, 1975; Nwosu et al, 1982; Brieger et al,1983;

Brieger and Guyer, 1990; Adeyeba and Kale, 1991; Edungbola et al, 1992; Tayeh and Cairncross, 1996; WHO, 1998);

Much has also been researched into the feasibility of the global initiative to eradicate the disease (Hopkins, 1976, 1983, 1984; Hopkins and Ruiz-Tiben, 1991; WHO, 1992; Dowdle and Hopkins, 1998; Carter, 1999; Aylward et al, 2000);

Starting from the mid 1950s Ghanaian health professionals have paid attention to the presence of the disease and its socioeconomic effects in the country, and the efforts the nation has been making to eradicate it (Waddy, 1956; Scot, 1960; Belcher et al, Lyons, 1972, 1973; 1975; Wurapa et al, 1975; Bugri, 1981, 1993; Tayeh et al, 1993; Olsen et al, 1997; Hunter, 1997; Tayeh and Cairncross, 1998; Zucker, 1998; Cairncross et al, 1999).

However, there is little information on the contribution of the programme in transforming the socio-economic and behavioural changes of communities in which the disease was endemic, making it necessary to investigate the socio-economic and behavioural trigger and trickle down effects the progamme may have contributed in guinea worm endemic communities. The research therefore tried to investigate the role the programme played in transforming the socioeconomic conditions of in guinea worm endemic areas after operating in the country for the past twenty two years.

Twenty two years into the programme and with the success of bringing the number of reported cases of infections to zero in July 2010 (Public Health Division, 2010), this study examined the effectiveness of the GWEP in eradicating the disease and, determined its effects on health and socio-economic development in the Northern Region.

1.3 Objectives

The broad objective that guided the conduct of the research was the analysis of the effectiveness of the GWEP and determine its effects on socio-economic development in the Northern Region of Ghana.

More specifically the objectives included:

i. Examine the epidemiology of GWD in the Northern Region of Ghana;
ii. Determine the factors that led to the creation of the GWEP in Ghana;
iii. Examine the operations of the GWEP in the Northern Region of Ghana;
iv. Determine the factors that influenced the reduction in the number of cases of guinea worm infections in the region;
v. Determine the effects of the GWEP on health, socio-economic development in the region;
vi. Determine changes in people's behaviour towards the disease and their environment in the region; and,
vii. Examine the future of the GWEP in the prevention of guinea worm infection

1.4 Propositions

The research was guided by the following propositions:

i. Guinea worm infection was restricted to hyper endemic foci in the Northern Region of Ghana;
ii. The GWEP was effective only at the district level of health care delivery;
iii. The operations of the GWEP has influenced the introduction of improved innovations in the provision of potable water for the people in the Northern Region of Ghana; and
iv. The GWEP would continue to operate by winding up its operations to pursue a policy of devolution to consolidate its hold on its objective of eradicating guinea worm as a disease of socio-economic importance in Ghana.

1.5 Hypothesis

Ghana's success in eradicating the disease was examined with respect to the provision of potable water and the increase or decrease in the number of cases of guinea worm infections:

i. H^o – Increase in the provision of potable water did not cause a significant decrease in the number of cases of guinea worm infections;

The alternate hypothesis to the null hypothesis was:

ii. H^1 – Increase in the provision of potable water caused a significant decrease in the number of cases of guinea worm infections.

1.6 Research Philosophy

The philosophical world view that guided the conduct of the research was largely influenced by pragmatism as it examined the situation during the guinea worm epidemic and the consequences of the GWEP in transforming peoples' lives in the study area. It focused on the problem to be researched by using all approaches available to it. The research was therefore not committed to one system of philosophy and reality. Freedom of choice was therefore used to gather and analyze data. In this regard, social, historical, and political factors were used to investigate the problem. As a result the study opened the door to multiple methods, different world views, different assumption, and different forms of data collection and analysis.

1.7 Significance of the Study

Even though much has been researched into the effects of the guinea worm epidemic, not much has been researched into the effectiveness of the GWEP on the general health of people, and how the programme has transformed the socio-economic conditions of affected communities and the behavioural changes the programme made people of affected communities to adopt towards the disease. This has resulted in insufficient information to develop policies to sustain the gains of the programme.

This research is therefore expected to bring forth the strengths of the programme for recommendations to be made at the sectoral and global levels to sustain and advance the gains the programme has made with respect to the disease, and improving the socio-economic condition of the people in guinea worm endemic areas.

1.8 Limitations of the Study

The researchwas confronted with some challenges. Notable among them was the limited geographical coverage of the administration of questionnaire and Focus Group Discussions in the study area. It would have been ideal to cover many more villages; however, time and financial constraints limited the administration of questionnaire to a few villages.

Next was the problem of community conflicts hindering the administration of questionnaire in some areas. This resulted in some sections of the study areas refusing to cooperate with the research team, resulting in questionnaires being returned with apologies.

Another challenge the research encountered was that residents in more enlightened villages expected to be rewarded financially before responding to questions. This situation caused the research team to always relocate to communities which were ready to respond questionnaire. The research also encountered the problem of the undisclosed expectations of some interviewers with respect to remuneration. The research originally settled on two field workers for each district; but as the field work progressed some field workers brought on board other workers the research did not budget for. This put an unexpected strain on the financial resources of the research research, which had the potential effect of disrupting the good interpersonal relations which was developed at the initial stages of the field work.

1.9 Structure of the Thesis

The thesis was organized into the following chapters:

Chapter One – Research Problem and Objectives

This chapter outlines the origins of the guinea worm epidemic and the GWEP in Ghana, and justifies the need for the research after 22 years of existence in the country. It then outlined the objectives for the research based on which the hypothesis for the research was formulated.

Chapter Two – Literature Review and Conceptual Framework

This chapter reviewed literature on the biology and treatment of the disease, and the socio-economic effect of the disease on communities in which the disease was endemic. The benefit of global co-operation and intervention measures to eradicate GWD in the world was examined. Literature on disease diffusion and disease ecology was reviewed to develop a hybrid conceptual framework of disease diffusion and disease ecology.

Chapter Three – Study Area and Methodology

The study area was examined focusing on sources of drinking water. This was followed with sources of data and methods used to gather information for the research. The ways in which data was analyzed and presented are discussed.

Chapter Four – The Epidemiology of the Guinea Worm Disease in the Northern Region of Ghana

The contents of this chapter examined the causal factors which exposed people of the study area to the disease and the levels of severity of the epidemic in each endemic administrative district. The demographic characteristics of respondents is outlined.

Chapter Five – The Determinants of Guinea Worm Endemicity and its Socio-economic Impacts in the Region

This chapter examined respondent's knowledge of the disease and how their sources of drinking water affected their condition of health during the epidemic. The socio-economic effect of the epidemic in the study area is examined.

Chapter Six – The Guinea Worm Eradication Programme in the Northern Region

The chapter traced the origins of the GWEP in Ghana. It determined which factors in the opinion of respondents was responsible for the eradication of the disease in the Northern Region. A look was taken at the relationship between the provision of potable water and the decrease in the number of cases of guinea worm infections.

Chapter Seven – Impact of the Guinea Worm Eradication Programme on health and socio-economic development in the Northern Region

This chapter focused on the GWEP's contribution in improving the health and socio-econmic welfare of people in the study area.

Chapter Eight – Behavioural change after the implementation of the Guinea Worm Eradication Programme

The contents of this chapter was about the role the GWEP played in changing people's behavior towards GWD and their environment.

Chapter Nine – Summary, Conclusion, Recommendations and Policy Implications

This chapter drew conclusions on the effect of the guinea worm epidemic on people's health and socio-economic wellbeing. The effectiveness of the programme in eradicating GWD and contributing towards improving socio-economic welfare and changing people's behaviour towards the disease and their environment is discussed. It then recommends the continuity of the programme to ensure that the disease is permanently brought under control.

CHAPTER TWO

LITERATURE REVIEW AND CONCEPTUAL FRAMEWORK

2.1 Introduction

This chapter addressed issues concerning existing knowledge about guinea worm and how it affected humans with respect to its clinical manifestations and the various stages at which humans can avoid infection or get treatment when infected with the worm. Also the epidemiological aspect of the disease was examined to establish how humans are exposed to the infectious agent of the guinea worm. Additionally, the socio-econmic effect of the disease was reviewed to re-echo the devastating consequences that an epidemic could have on a people. The eradication initiatives and the intervention measures that were implemented to curb the epidemic, were discussed to set the stage for the examination of the effectiveness of the GWEP in eradicating GWD and the socioeconomic impacts and attitudinal changes the programme may have brought to the Guinea Worm Freed Areas of Ghana, and the Northern Region in particular.

To determine gaps in knowledge for the research literature was reviewed along the following themes: biology and treatment of the disease, socio-economic effect, and, national and global initiatives to eradicate the disease. It was realized from these themes that little research has been conducted in evaluating national and global efforts to eradicate the disease and how these efforts have contributed in transforming socio-economic development in endemic areas.

The concepts of disease diffusion and disease ecology were reviewed to develop a hybrid conceptual framework of disease diffusion and disease ecology to explain the local survival of the guinea worm copepod and its subsequent spread to cover wider geographic space, and how the programme was able through its intervention measures to curb the chain of

transmission of guinea worm infections between infective or susceptible communities and wider geographic space.

2.2 Biology of the Disease

2.2.1 Morphology

The species that causes the disease in humans is *Dracunculus medinensis*. Spirurids are tissue parasites. It takes its origin from the nematode superfamily *Dracunculoidea* of the order *Spirurida*. The eggs they produce contain larvae. The larvae require anthropod intermediate hosts. The commonest of these spiruds are the filariae and the parasite that affects humans, *Wuchereria bancrofti, Brugia malayi, and Loa loa* (Cairncross et al, 2002).

Even though *Dracunculus* was included among the filariae it differed from them in the size of the sexes and in their life history. The validity of the relationship among the various groups of spirurids has been supported by studies of small sub-unit RNA sequences (Cairncross et al, 2002). Similar species of *Dracunculus* have been reported for mammals and reptiles (Cairncross et al, 2002).

A mature female of *D. medinensis* is one of the longest nematodes one can possibly find. On the average it measures up to 100cm and 1 to 2 cm in width. Its vulva is in between its body. Microfilariae prelarvae emerge from the vulva. In *Dracunculus* it is closed with a plug and the whole body cavity is filled with the uterus. The uterus extends anteriorly and posteriorly. It contains from 1 to 3 million first stage larvae. The female gut is flattened and is non-functional (Cairncross et al, 2002).

2.2.2 Life Cycle

Mature female worms live in the subcutaneous tissues. They migrate to the surface of the skin. This results in blisters being formed. The blisters eventually burst and cause the anterior

end of the worm to be exposed. When the affected part of the body gets cooled by immersion in water, first stage larvae are ejected from the ruptured uterus.

The ejected first stage larvae measure 643 (490 to 737) by 23 (18 to 24) µm with a pointed tail and a fully formed gut. The larvae exhibit an active water life and live a few days in water (Cairncross et al, 2002). To develop further first stage larvae must be ingested by predatory copepods. The copepods normally measure 1 to 2 mm. Copepods were once included in the single genus cyclops (Cairncross et al, 2002). This classification has been revised and the intermediate host now belongs to the genera *Mesocyclops* (*M. aequatorialis*, and *M. kieferi*), or *Metacyclops* (*M. margaretae*), or *Thermocyclops* (*T. crassus, T. incisus, T. inopinus,* and *T. oblongatus*). Larvae must progress from the first stage to the infective third stage in the body cavity of the predatory copepods. The period over which first stage larvae develop to infective third stage larvae is 14 days, at a suitable temperature of 26°C (Cairncross et al, 2002).

Third stage larva develops further when the host copepod is ingested in drinking water in ponds and wells. When the copepods eventually gain entry into the human body, larvae are released and migrate through the intestinal walls, across the peritoneal cavity, into the abdomen and thorax within 15 days. Mature males and females mate after two months. This occurs in about a 100 days. The males die within a few months while the females persist. (Cairncross et al, 2002).

Experimental infections using *dracunculus insignis* revealed that males may live for a minimum of 330 days (Brandt et al, 1990) and may therefore be able to fertilze females for a period of two years before dying off (Cairncross et al, 2002). Within 10 months of inhabiting

the muscles of humans the female develops enormously in size, with its uterus filled with larvae. The larvae emerge from its host after about 1 year of infection. The points from which larvae emerge are mostly the feet and lower limbs of humans (Cairncross et al, 2002).

The period for larvae to develop through its three stages before infecting humans and emerging from them as adult worms is about a year. This makes transmission to take place at the most favourable season. There are however individual cases when larvae can develop and emerge from humans within a much longer period; in some instances 14 months (Cairncross et al, 2002).

2.2.3 Zoonotic Aspects

It is a very difficult task to eradicate a human disease if the disease has animal reservoirs of infection. There is no evidence to show that animals have ever been reservoir hosts of guinea worm infection. Cairncross et al (2002) suggest that animal infections in areas where the disease has been eradicated but without much success in providing potable water sources might provide useful information regarding the question of the possibility of animals acting as reservoirs of guinea worm infection.

Female worms are recovered from mammals in guinea worm endemic and non guinea worm endemic areas of the world. In most cases a portion of a female worm is recovered in a flaccid state after larvae have been ejected. In this state species identification is impossible. For easy identification guinea worm in mammals in the Old World and South America are classified as *D. medinensis* and in North America they are classified as *D. insignis* (Cairncross et al, 2002).

The incubation period of *Dracunlus* in mammals is very short, lasting for a few weeks. Worms that emerge from fur-bearing mammals are not easy to see, thus increasing the

likelihood of infections being much more common in many countries than is currently recognized. For example, in the southeastern United States and southern Ontario in Canada there are one or two reported cases of infection in wild carnivores and domestic dogs each year. In cases where raccoons were dissected and worms were found prevalence rates of 13.8% to about 50% were recorded (Cairncross et al, 2002).

The taxonomic status of guinea worm in North America was described by Leidy (1858) and later confirmed by Chitwood (1950) as being different because of the length of the gubernaculum and number of preanal papillae from males of *D. medinensis*. Further descriptions of *D. medinesis* proved that the differences observed by Leidy and Chitwood were not sufficient to be considered valid, and so the species was not accepted by all authorities. For instance, Faust et al (1968) stated that "In resrvior hosts *D. medinensis* is found in fur-bearing mammals in North America." (Cairncross et al, 2002). Cairnross etal (2002) have concluded that if these parasites are of the human infecting species then there is hope for eliminating human infections of guinea worm in the world.

Isolated human cases of dracunculiasis have been reported for Japan, Korea, and Indonesia. In these cases, infection was probably contracted from ingesting raw freshwater fishes. In situations such as this, immature parasites ingested in cyclops can survive but they do not develop. GWD has been transmitted experimentally by amphibians in North America. Experimentally, rodents can get infected. Infections in domestic animals are possibly of human origin. This is supported by the high prevalence rates when dogs were dissected in Uzbekistan in the 1920s. After a period of roughly 74 years the worm is still found to infect dogs in the endemic areas of Uzbekistan, Tamil Nadu and in the less endemic area of Azerbaijan, Kazakhstan and, Turkmenia (Cairncross et al, 2002).

In many parts of the world there are widespread and underreported and unreported cases of animal cycles of guinea worm infection that are completely independent of human infection; for there was a recent report that noted infection of *D. medinensis* in a cat in China. Uzbekistan, by 1931 eliminated the disease. The disease has not been able to recrudesce even though 40% of the rural population does not have piped water, whiles 33% in the area surrounding the historic focus of Bukhara have piped water. Egypt, Iran, Gambia, and Guinea eradicated guinea worm decades ago, and the worm has since not been recorded in the health reports of these countries (Cairncross et al, 2002). From the foregone it can be concluded that animal infections of *D. medinensis* is unlikely to be a public health problem if complete eradication of the disease in humans is achieved by making sure that safe drinking and bathing water sources are provided.

2.3 Clinical Aspects

2.3.1 Clinical Manifestations

Pre-emergent female worms are capable of moving freely within the connective tissues of an infected person. Just before a female worm makes its appearance at the surface larvae are released into the sub-dermis through a rupture at the anterior end. The release of larvae at the anterior end produces a host reaction. The host reaction causes burning and the development of painful blisters. The blisters after a few days burst, giving a shallow ulcer. This is followed by an inflammatory response against the cuticle of the entire worm, preventing its removal (Hours and Cairncross, 1994; Muller, 1976).

When the process of larvae being expelled is completed, the end of the worm dries up, with the complete worm becoming extruded within a few weeks. The lesions get resolved quickly. In some cases which turn out to be unpropitious the track of the worm gets secondarily infected, severely disabling patients for a considerable length of time. The following accounts by Caircross et al (2002) go a long way to substantiate the preceding assertion:

> "In [a] study in …Nigeria, 58% of patients, mostly in the 15 to 49 year old working age group or of school age, were disabled for an average of 12.7 weeks during the yam and rice harvest time." (p. 227)
>
> "In a study in Ghana, 28% of patients had continuing pain between 12 and 18 months after emergence of worms; and 0.5% … had permanent physical impairment, in the form of locked knees or other joints." (p. 227)

There are times when a worm may burst in the tissue of infected people. This produces a pus-filled abscess and may be accompanied with severe cellulites. Infertile worms, whether female or male, when they burst within tissues because of some form of inflammatory reaction, may end up calcifying.

2.3.2 Pathogenesis

GWD has been found to be unusual among parasitic infections. This situation has arisen because there is insufficient proof of acquired immunity, thus making it possible for the same person to be re infected more than once (Muller, 1976).

2.3.3 Diagnosis

A person infected with guinea worm will immediately know what they are suffering from, when or just before a blister forms from local itching, followed by sharp pain with general allergic symptoms and urticaria flow. When a guinea worm blister opens, cold water triggers a process of the release of larvae (Cairncross et al, 2002).

Larvae can be seen under a low power microscope. Immunodiagnostic methods are not helpful in seeing larvae because there is not enough proof of the method being able to detect infections which are obvious, because of the lack of appropriate serum samples. Antibodies are detected in patent infections, using enzyme-linked immunosorbent assay, or dot-enzyme-linked immunosorbent assay, using whole worm antigens. The most specific reaction is for the detection of immunoglobin G4 (Bloch et al, 1993). This test is expected to uncover

highly undetectable infections up to 6 months before the emergence of blisters (Bapna and Renapurkar, 1996).

2.3.4 Treatment

A classical treatment method is the process of winding worms out on a stick. A few centimeters are wound out in a day. This practice has been in existence from antiquity. In modern times worms are extracted using a clean dressing and antibiotic ointment. This addition prevents secondary bacterial infection. So far it cannot be proved that chemotherapeutic agents have had a direct effect against worms (Magnussen et al, 1994). Some benzimidazoles are likely to have an anti-inflammatory action on worms. The action of benzimidazoles contributes to the elimination of worms in infected people (Nwoke, 1992). The action of asprin was found in some places to be equally effective in getting rid of emerging worms in people.

Ivermectin, also called Mectizan, is a successful drug against other nematodes; but with regard to the guinea worm it has been completely incapable of having the required action against it (Eberhard et al, 1990; Issaka-Tinorgah, 1994). Treatment with mebendazole caused abberant migration of worms. Action from mebandazole made worms to emerge at unsuitable parts of the human body (Chippaux, 1991), thus making the process of worm-winding-out very delicate and uncomfortable (Cairncross et al, 2002). Due to the inability of drugs to treat guinea worm the only reliable method for treating people who are infected with guinea worm is the surgical extraction of worms when worm winding out gets complicated.

2.4 Socio-economic Impact

The biological and technical feasibility of controlling a disease is not the only thing that is considered before a health control or eradication programme is embarked on. The social and economic cost of the epidemic and the social and economic benefits that will accrue if the

disease is brought under control are assessed, to justify the implementation of a disease control or eradication programme (Dowdle and Hopkins, 1998).

When guinea worm infection was not considered as a disease of socioeconomic importance, most cases of guinea worm went unreported on grounds that health centres could offer only palliative treatment to patients. Patients of guinea worm infection lived in remote rural areas that were difficult to have access to; and finally, that most patients of guinea worm infection recovered naturally once the worm was expelled. Cairncross et al (2002) captured the situation of unreported guinea worm cases when they said:

> 'a large teaching hospital in Nigeria never saw dracunculiasis cases … although the disease was endemic in villages a few kilometers away. Because few cases were reported, the disease was often considered an exotic curiosity rather than a major public health problem.'(p.227)

However, in places of hyper and meso endemicity (Cairncross et al, 2002) the social, economic, nutritional, and educational effects, and the expenses people incur at the individual, the household and community level can be challenging.

2.4.1 Disability

GWD hardly kills its victims. Medical records on guinea worm infection in India revealed a fatality rate of 0.1% or less. This was a generous estimate, since it was only those with serious complications who go to health facilities for treatment. Those who were permanently disabled by the disease have been put at not more than 1% (Imtiaz, R. et al, 1990).

The social effect of guinea worm infection is considered to be the disability that patients of the disease suffered. Longitudinal studies in Nigeria showed that as much as 58% to 76% of patients were temporarily bedridden for approximately one month when the worm made its

appearance on the outer surface of their skins (Adeyeba and Kale, 1991). In about half of the cases considered severe and protracted disability was common with secondary infection of lesions (Nwosu et al, 1982; Wurapa et al, 1975).

An extended effect of the temporary disability that patients suffered was the seasonal pattern of worm emergence, mostly reaching their climax at periods when agricultural labour was much in demand (Smith et al, 1989). This cycle of the periodic emergence of the worm during the peak of the farming season meant that whole communities could be grounded with respect to farm labour (Belcher, 1975). The situation of insufficient farm hands to increase food production as a result of the debilitating effect of the disease, made the people of Dogon in Mali to refer to the disease as "the disease of the empty granary" (WHO, 1998).

The effect of the disease does not end when the patient has been successfully treated. Studies in Ghana showed that between 12 and 18 months after a worm emerges 34% of patients had difficulty carrying out tasks that required some physical exertion as a result of the pain they experienced; this was attributed to the location of the worm in the human host and the date of the onset of worm emergence. This disability was not permanent; however, it extended beyond the incapacitating period of worm emergence (Hours, and Cairncross, 1994).

2.4.2 Economic Impact

Attempts were made at determining the economic effect of the guinea worm epidemic on the lives of the people living in guinea worm endemic areas by multiplying the number of days of labour lost by the mean value of production in a day or by the wage rate. The loss per household was then multiplied to give the estimated cost for a region's economic loss (Kim et al, 1997). A survey of 87 households by de Rooy and Edungbola (1988) estimated that three states in southern Nigeria that had hyper to hypo endemic levels of guinea worm endemicity

sustained an annual loss of $ 20 million. In the opinion of Edungbola et al (1992) their 1988 study of 87 households was the force that persuaded senior politicians to mobilize funds to eradicate guinea worm infection in Nigeria. It has been argued that the method for calculating the economic effect of a disease on a population was too simple and was likely to overestimate what was lost economically to households and a region. This was because the method did not make room for the coping strategies that households adapted to illness (Guiguemde et al, 1986; Paul, 1988) and which have been found to be common in peasant farming communities (Brieger, 1989; Chippaux et al, 1992). An approach that was considered to be representative of the economic effect was the examination of the effect on actual production. This would include the incidence and duration of guinea worm induced disability, as predictive variables in an agricultural production function (Brieger and Guyer, 1990). This approach was used by Audibert (1993) in northeastern Mali where the prevalence of guinea worm infection was between 3% and 33%, to show that temporary disability accounted for a 5% reduction in the overall production of subsistence crops, with sorghum and millet being the most important.

There was also the coping strategy which considered the mutual assistance that transfered the cost of the disease to other households. It was considered to be of little help to labourers. The approach was, however, considered too simple for determining the economic effect of an epidemic on a household and for the population of an endemic area (Watts et al, 1989; Chippaux, 1992). The Disability Adjusted Life Years was considered a suitable alternative to assess the economic loss an epidemic brought on households and entire endemic areas.

2.4.3 Nutrition

The way a disease impacts on the production of some crops can have a disproportionate effect on the nutritional status of communities affected by the guinea worm epidemic

(Brieger and Guyer, 1990). Tayeh and Cairncross (1996) found out in a survey in Kordofan, Sudan, that in households where more than half of adult members had suffered from guinea worm infection in the previous year, children below 6 years from these houses were three times more likely to be malnourished.

2.4.4 Education

GWD adversely affected children's education. In rural Africa schools for children are a long walk away from home. When children contracted the infection they missed school, partly because of the long distances they had to cover. They also may miss school when parents and guardians were taken ill with the disease by having to substitute them in doing agricultural work and other household jobs. This resulted in school attendance suffering a decline during the peak seasons of guinea worm infection, with schools in areas of hyper endemicity experiencing sporadic closures for an accumulated period of about 1 month within the school year (Brieger et al, 1983; Edungbola et al, 1985; Edungbola et al, 1988; Illegbodu et al, 1986; Nwosu et al, 1982).

2.4.5 The Benefit for Global Cooperation

The outbreak of the guinea worm epidemic was of particular interest to the world economic community, both at the national and international level. This was because it had a direct and measurable effect on production, and also because a successful eradication effort will bring along with it a host of benefits to the community of nations. During one of its cost benefit analysis for the eradication of guinea worm the World Bank examined the benefits that will accrue from reducing the prevalence of the disease, and estimated that the global community will reap a 29% economic return when prevalence of the disease is reduced to zero (Kim, et al, 1997). This estimate, Paul (1988) concluded, was certainly pessimistic.

2.5 Epidemiology

2.5.1 Water Sources

A Dracunculus larva uses a period of 12 to 14 days to develop in cyclops to become infective. It is rare to find the larvae of the guinea worm in flowing water, like rivers and streams. Deep wells are also an unlikely source of guinea worm infection (Cairncross and Tayeh, 1988; Muller, 1979). Few cyclops are found in deep wells. This could be due to the fact that the absence of light at the bottom of such wells does not encourage the growth of zooplanktons, the plants on which cyclops feed (Brandt and Eberhard, 1990; Fedchenko, 1971). Ponds and shallow wells or step wells were the main source of guinea worm infection (Tayeh et al, 1993).

Several studies in, Nigeria (Kale, 1977; Edungbola, 1980, 1983; Edungbola and Watts, 1984, 1985, 1990; Osisanya et al, 1986), Ghana (Scott, 1960; Lyons, 1972; Belcher et al, 1975; Bugri, 1981), Burkina Faso (Gbary et al, 1987), Togo (Petit et al, 1989), Uganda (Henderson et al, 1988), Pakisatn (Hopkins et al, 1995), India (Johnson and Joshi. 1982), and Uzbekistan (World Health Organization, 1998) have shown that ponds are the major source of guinea worm infection.

Some of the ponds that transmit guinea worm are man-made ponds. Steib and Mayer (1988) found that the village of Dara with semiarid and sahelian conditions in Northeast Burkina Faso had a large number of ponds; but few of them were man-made. These man-made ponds had smaller surface diameters (4-9 m) as compared to small natural ponds (7-15 m) with shallow maximum depths (30-55cm) as compared to large natural ponds (100-130cm).These small ponds increased the exposure of residents of Dara to the transmission of guinea worm.

There are man-made ponds larger than those identified by Steib and Mayer that have been found to transmit guinea worm. These ponds include large ponds excavated for community water storage on the Mossi plateau of central Burkina Faso (Kambire et al,1993); small dams in northern Ghana (Bugri, 1981; Tayeh and Cairncross, 1998); 'ataparas' also called valley tanks and similar to reservoirs in northern Uganda (Henderson et al, 1988); several drinking water ponds in Anambra State, Nigeria; 'hafirs' in Sudan (Cairncross and Tayeh, 1988); and municipal ponds in some parts of Uzbekistan.

There were times when the outbreak of guinea worm was attributed to the construction of large dams (Adekolu-John, 1983; Edungbola and Watts, 1984). Cairncross et al (2002) noted that the role of large dams in the transmission of guinea worm resulted from the use of ponds which developed from receding dam water during water level drawdown periods. There are different types of wells and storage tanks. Some of these wells include the rectangular mansonry-lined step well of India, the shallow wells in Mali, scoop wells, and the "berkeh" water storage cisterns of Iran. These wells have been found to be sources of guinea worm infection. Singh and Raghavan (1975) concluded that rectangular mansonry-lined step wells were the principal sources of guinea worm infection in Rajasthan, India. Ranque et al (1979) identified shallow wells to be the principal source of guinea worm infection in Mali. Cairncross and Tayeh (1988) found scoop wells dug in sandy river beds to be a probable source of guinea worm infection. They (Cairncross and Tayeh, 1988), however, added that 'if these water holes are exhausted by the drawing of water each day, no cyclops population can be sustained in them, and so transmission cannot occur'(the language is Cairncross et al's, 2002). In Iran Sahba et al (1973) found the "berkeh", a traditional covered water storage cistern, to be the main transmitter of guinea worm.

Guinea worm has been transmitted from rainwater storage reservoirs used by individual households in Sudan (Cairncross and Tayeh, 1988). In an isolated case in Libya a guinea worm infected migrant worker contaminated a farm tank which in turn contaminated a buried reservoir (Karam and Tayeh, 1999). This mode of guinea worm transmission is rare. This is because 'there must be an index case in the household to contaminate the reservoir…'. When water gets contaminated in this way transmission is more intense than usual because the infected cyclops are contained in a smaller volume of water. This was reflected in the average number of worms per patient being high (Cairncross and Tayeh, 1989).

2.5.2 Villages of endemicity

The transmission of GWD depends on the characteristics of the water source. This has an important consequence for the design of guinea worm eradication programmes. This occurs in a limited number of 'villages of endemicity', on which eradication activities can focus. In 1990 a national case search conducted for 8, 068 villages in Burkina Faso found confirmed cases of guinea worm infections in 2, 621 villages (Kambire et al, 1993). It was found in the province of Bam that villages with ponds were twice as likely to be among villages of endemicity.

In Ghana a national case search for confirmed cases of guinea worm infections was conducted in 1989 to establish the number of guinea worm endemic villages in the country. The results of the search showed that 179 843 indigenous cases of guinea worm infection were found in 6515 villages throughout the country, giving an average of 28 cases of guinea worm infections per village (GGWEP/GHS, 2012; Diamenu and Nyaku, 1998). This indicated that the disease prevailed in Ghana largely at an hyper endemic level. In some countries, villages of endemicity show a prevalence rate of about 30 % per year.

The appearance of a large number of new villages of endemicity seems to be the result of cases reappearing in villages that were prematurely removed from the endemicity list (Lucas et al, 1999). There was no change in the classification of villages susceptible to the disease. A period of one year was not sufficient evidence to indicate the interruption of guinea worm transmission; because the full cycle from the emergence of a worm to its detection took 16 months.

2.5.3 Seasonality

The time it takes for a worm to emerge from its human host between the ingestion of infected cyclops to the emergence stage of the worm is approximately one year. This makes *dracunculus* to be suited for environments in which transmission occurs at a particular time of year. Because of this there was a strong seasonal peak in incidence rates in most communities of endemicity.

There are two broad patterns of seasonality in African areas of endemicity. These patterns depend on climatic factors. In some countries both patterns occur in different climatic zones. In the sahelian zone, transmission of guinea worm is limited to the rainy season (Guiguemde, 1985). Steib and Mayer (1988) explained the occurrence of this pattern to the presence of *T. inopinus* in surface and shallow sources of drinking water. Most of these water sources dry up; and hand pumps are repaired in the dry season, making the population vulnerable to surface sources of water supply (Curtis et al, 1993).

In the humid savanna and forest zone the opposite pattern was found. Peaking of guinea worm infections occurred mostly in the early dry season. This situation occured in some parts of the Oyo state in Nigeria (Edungbola and Watts, 1990; Kale, 1977); Danfa in Ghana (Belcher et al, 1975); and southern Togo (Petit et al, 1989). In Ghana the disease persisted until the dry season ends (Belcher et al, 1975; Bugri, 1981; Lyons 1972; Scott, 1960). This

situation held true for southern Benin (Chippaux and Massougbodji, 1991), Kwara and Anambra States in Nigeria (Abolarin, 1981; Edungbola, 1983; Edungbola and Watts, 1985; Nwosu et al, 1982) and in Uganda (Henderson et al, 1988). Dry season transmission was associated with the consumption of water from ponds and water holes dug in the beds of seasonal rivers when flow had ceased (Chippaux et al, 1992; Macpherson, 1981).

It has been suggested that transmission does not occur when there is less than one susceptible cyclopoid per liter in the pond, accounting for seasonal variations in incidence (Chippaux and Massougbodji, 1991). In some cases the duration and intensity of transmission could depend on dams and ponds drying up in the previous year (Tayeh and Cairncross, 1998). Some villages had seasonal peaks different from those of surrounding communities. This was sometimes attributed to local circumstances. For example, villages along the banks of the Niger and Volta rivers experienced upshots of guinea worm cases when river levels fell and water taken from holes dug in the river's bed (Adekolu-John, 1983; Tayeh et al, 1983).

2.5.4 Individual Risk Factors

The incidence of guinea worm infections was found to vary with age and sex. This was understood from the way people of different ages and genders behaved with regard to their sources of drinking water (Nwoke, 1992). A high prevalence rate was found in women in Ethiopia (Jemaneh and Taticheff, 1993). The opposite was true for men in India (Johnson and Joshi, 1982) and West Africa (Adekolu-John, 1983; Chippaux et al, 1991; Nwoke, 1992). When the risk factors (such as work in the field or collection of water) that exposed people to guinea worm infection were considered in totality, age and sex differences were found to be insignificant (Tayeh et al, 1993).

In a survey of 27 villages, it was found four high prevalence villages which had polluted sources of water supply which infected children and adults in ways similar to infection based

on sex and gender roles in Ethiopia, India, and West Africa. The remaining 23 villages in the study area showed lower prevalence rates in all ages but significantly less in children than in adults. Prevalence in the first four communities was connected with water that got contaminated in people's homes. Prevalence in the last 23 communities was connected with mobility, where infection was acquired from water sources outside the community (Cairncross et al, 2002).

Other risk factors associated with guinea worm infection had to do with mobility (Watts, 1984). The most important risk factor that exposed people to guinea worm infection was infections in the previous year. Few people suffered recurrent infection even though they drunk from the same sources of water supply as the rest of the population. This reflected the variability of individuals' susceptibility to being infected with guinea worm (Chippaux et al, 1991; Lyons, 1972; Tayeh et al, 1993).

2.5.5 Eradication Initiatives

It was realized that GWD was one of the diseases that could be successfully eradicated (Muller, 1979). The cyclop is not a mobile vector. The carrier state of the worm in the cylops and human hosts is of limited duration. It is easy to diagnose a case of guinea worm. Measures to prevent transmission of the guinea worm are cheap and effective. The geographical distribution of guinea worm was limited and it was found in specific communities of endemicity. The seasonal distribution of infection permited an intensive focus on its prevention in seasonal campaigns. The transmission of guinea worm from animals to people was practically unknown (Cairncross et al, 2002).

The idea that GWD could be eradicated fell on fertile ground when small pox, the world over, got eradicated by 1977 and river blindness was brought under control by 1994 in Africa and other endemic foci of the world (Hopkins, 1976; Sharma, 1980; WHO, 1994). An initiative to

eradicate the disease was seen by health professionals and members of the international academic community as a rehearsal towards the eradication of poliomyelitis, especially in the troublesome social and political terrain of Africa where the last cases of guinea worm and poliomyelitis may occur (Brieger, 1996).

The Centre for Disease Control and Prevention through an advocacy campaign that begun in 1980 and which was sustained for over a decade managed to convince President Jimmy Carter, the United Nation's Children Fund (UNICEF) Executive Board, the 1989 African Regional Committee of the World Health Organization, and the 1990 World Summit for Children to take up the challenge (Hopkins, 1983; 1984; 1987; 1990). As a result of the Centre for Disease Control and Prevention's successful advocacy campaign to eradicate guinea worm in 1991, the WHA declared its commitment to the goal of eradicating the disease by the end of 1995. This date was technically feasible given appropriate political, social and economic support. This target date was set in order to enhance advocacy efforts at the international level and in countries of endemicity (CDC, 1989)

The advocacy effort was replicated in other countries to get national guinea worm eradication programmes established (Edungbola et al, 1992). India was the first country to initiate the first guinea worm eradication programme. This was in 1982. Ghana initiated her's in 1989; and by the close of 1990 countries like Nigeria, Cameruon, and Pakistan rolled out their guinea worm eradication initiatives. By 1995 these eradication programmes began to record substantial and progressive reductions in the prevalence of guinea worm infections in their respective countries (WHO, 1998).

The advocacy effort was maintained to sustain the interest of donor agencies to continue their water supply programmes, to make technical assistance available, to provide vehicles, filter cloths, and temephos; train staff; and, support the guinea worm eradication initiative financially. An added objective of the advocacy effort was to keep up the commitment of countries of endemicity, and that of the eradication programme staff. Regional conferences and meetings of national programme coordinators and program review meetings were held for coordinators to present their programme activities to their colleagues from neighbouring countries. Donor involvement and coordination was provided by way of regular interagency meetings. These meetings were attended by representatives of the Carter Center, UNICEF, the U.S. Agency for International Development, the World Bank, and the WHO. High level advocacy was achieveded by involving President Jimmy Carter, Yakubu Gowon of Nigeria, and A. T. Toure of Mali (Carter, 1999).

The major stakeholders for the programmes to eradicate guinea worm at the international level were the Carter Centre, UNICEF, the World Bank, and WHO. Other supporters of the guinea worm eradication initiative who channelled their funds through the agencies mentioned above included the Bill and Melinda Gates Foundation, and the British and Japanese bilateral aid programmes. The agencies which financed the guinea worm eradication initiative worked at identifying gaps in the funding of national programmes. Many national guinea worm eradication initiatives were started between 1992 and 1996. UNICEF and WHO had a joint technical team to provide national programme coordinators with the needed technical support. The careful planning and execution of the initiative to eradicate GWD, both at the international and the national levels, resulted in a 98% reduction in the number of cases of guinea worm infections, from an estimated 3.3 million in 1986 to 75, 223 cases in 2000 (CDC, 1986; WHO, 2001).

2.6 Interventions

The initiative to eradicate guinea worm developed and selected some intervention measures for the prevention of the disease. Field experience is very important in every disease control initiative. Most disease control programmes succeeded by relying on systematic evidence from the field. Mistakes may be made in the process of bringing a disease under control; but experience being a good teacher gives dedicated scientist the opportunity to learn from such experience (Liese, B. H. et al, 1991).

The interventions which were developed to combat the guinea worm epidemic was done with reference to the life cycle of the worm, and the fact that an effective vaccine against the disease had not yet been developed. The following measures have become internationally accepted measures for the control of guinea worm infection: (i) provision of safe water supply (ii) filtration of drinking water to remove cyclops (iii) searching for patients with active cases and properly managing them, (iv) avoiding patients contact with ponds and (v) killing or removing cylops in ponds (Caircross et al, 2002).

2.6.1 Safe water supply

It was universally accepted that the provision of safe water supply was the best intervention measure to adopt to prevent the spread of guinea worm infection (National Research Council, 1983). The eradication goal was set as the target objective for the International Water Decade (Hopkins, 1983, 1984).

Nigeria and Benin from the onset of their Guinea Worm Eradication Programmes placed emphasis on the construction of safe water supply facilities (Edungbola et al, 1988,1990; Huttly et al, 1990). The works of Bhatt and Palan (1978) in Gujarat, India, and Johnson and Joshi (1982) in the Barmer District also in India; Cairncross and Tayeh (1988) in Kordofan, Sudan; Edungbola et al (1988) in Asa, Nigeria; Henderson et al (1988) in Uganda; Lyons

(1972) in the Wa District of north western Ghana; Udonsi (1987) in the Imo State of Nigeria; and Reddy et al's (1969) epidemiol ogical study on guinea worm infection all testify that there was a positive effect of potable water supplies on the control of guinea worm infection. The studies of these authors were conducted at least 1 year after the provision of potable water to these communities. It was only in the Kwara State of Nigeria that studies were carried out 3 years after potable water was supplied to guinea worm endemic communities.

2.7 Conceptual Framework

The conceptual framework for the research was derived from fusing the ideas from the concepts of disease diffusion with those in disease ecology to produce a hybrid conceptual framework of disease diffusion and disease ecology. Haggestrand's (1968) theory of diffusion of innovation was incorporated into the hybrid conceptual framework of disease diffusion and disease ecology to explain how disease could diffuse over space, and how circumstances may resist its spread, and thus confine it to its local environment.

2.7.1 Disease Diffusion

Diffusion is the spread of phenomena, ideas, or techniques throughout a population or region. It incorporates the basic geographic elements of distance, direction, and spatial variation and thus forms a valid field of geographic interest.

Haggestrand (1968) suggests the spread of an innovation is the outcome of a learning process. This means that a theory on the spatial diffusion of innovation must examine the factors related to the flow of information. Some of the factors that affect the flow of information are personal characteristics which control the pattern of communication or the effect of a received message, intensity and frequency of messages, and the relationships between exposure to information about the innovation and reduction of resistance to adoption. An important step in examining the process of diffusion is to identify the spatial characteristics of information flows and resistance to adoption.

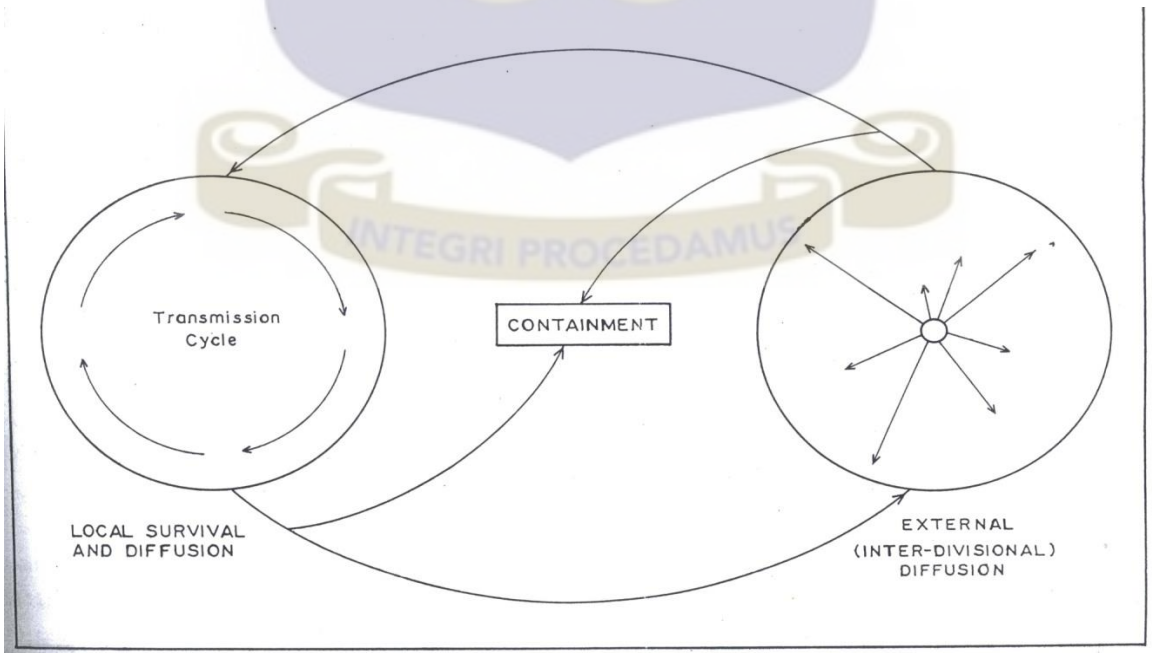
Haggerstrand asserts information develops in the form of messages. The destination of a message depends on the networks through which information flows. The network is primarily dependent on the presence of various barriers. There are terrestrial barriers which impede communication, e.g. lakes, forests, difficult terrain, and the geographical distance separating two potential adopters. Karlsson (1958) and Duncan (1957) suggest that social barriers are functionally similar to terrestrial barriers, and could be part of Hagerstrand's conceptual model. Haggestrand's concept also recognizes that resistance levels differ from individual to individual. The resistance level is a function of personal and group characteristics. Higher levels of resistance require the potential adopter to be well informed before adopting an innovation. Diffusion is based on an area or environment; a temporal dimension; the item being diffused; places in which the item is located at a time interval (nodes of origin); places in which the item is located at the end of a time interval (nodes of destination); and paths of movement, influence or relationship between the origin and destination places (Haggerstrand, 1968).

In addition to Haggestrand's studies on the diffusion of innovation (Haggestrand, 1965a, 1965b, 1967) and migration (Haggestrand, 1967, 1962) geographers have tried to relate the model to the diffusion of disease. Stock (1976) defines disease diffusion as the process of the spread of a disease through space over a period of time. Diseases have the tendency to spread outward from a central focus, and are described as "contact diffusion". If a disease enters a communitty, it is likely to diffuse to other communities. The long distance jump of an infection by a long distance traveler using a means of rapid transportation is relocation diffusion. The frequency and types of interaction by humans is crucial for adoption of innovation and disease diffusion.

The spatial diffusion of disease must be considered along the following lines: diffusion of the disease after its introduction into a population – local diffusion; and the spread of the infection from one subsection to another – external diffusion, for example between two regions or districts. Local diffusion is the survival and diffusion of an infection in a section of the population. External diffusion is the most effective way in which an infection comes into contact with an uninfected population, as shown in the model in Figure 2.1.

The basic components of disease diffusion are a system of interactions, and although both are diffusion processes there are considerable differences in the factors that govern them. Factors common to both types of diffusion may operate differently at the local level and at the interregional level. With respect to the model of local and external diffusion of disease the factors that may be responsible for the local survival and diffusion of a disease at the community level may be different from those that cause the external diffusion of the disease to cover other communities that were initially not affected by the disease.

FIGURE 2.1: Model of Local and External Diffusion of Disease



Source: Adapted from Stock (1976); Cholera Diffusion in Africa

Barriers, channel effects and central place attraction work together to make it possible to introduce a disease into certain locations, while reducing the chances of others getting infected. The effect of impermeable barriers reduces the volume of traffic. Diffusion through a permeable barrier is possible; but the probability is low. Channels provide paths of least resistance facilitating movement between points near the channel.

Movements may be facilitated by a reduction in the time, cost, or difficulty of the journey. Populations have unequal attraction for travelers. The importance of a place attracts more people to it. The functions which combine to constitute the central attraction for travelers are the volume of trade, markets, location of government, health, educational facilities, and traditional functions (Gould, 1969). Population size and employment opportunities for migrants are other aspects of central place attraction. Barriers, channels, and central place are closely related.

The transition from a conceptual to an operational model imposes some constraints on the type and range of real-world conditions that are to be examined. This reduces the range and applicability of the model when it is being applied to real world situations. Haggerstrand's model is very important as far as the local survival and spread of the disease was concerned. The spread of the disease after its initial introduction may involve the complex interaction of the crucial variables of agent-host-environment interrelationships. When the transmission cycle is established the disease will continue to spread until its equilibrium is disturbed. This makes the inclusion of the ecological approach in the study of diseases necessary.

2.7.2 Disease Ecology

The model for disease ecology is an illustration of the reciprocal relationship between infectious agents, hosts, and the environment. The agent is the immediate cause of a disease process. The infectious agents may be viruses, fungi, or helminths. The biological properties

of the agent play a major role in its epidemiology. A parasite is able to survive in the environment when its infectious agent is able to emerge from a host to reach a new host (Lucas and Gilles, 1973).

The presence of an infection and the outcome of it are determined by the host (intermediate and/or final) factors. Immunity describes the ability of the host to resist infection. The immune response of the host could modify the nature of the pathological reaction to infection. Characteristics of host involve qualities such as growth, constitution and aging. These characteristics may influence the state of health of the individual. Heredity, disease adaptive processes, social variables, immunity, and auto-immune processes influence the qualities and characteristics of the individual.

The environment is made of its real and abstract aspects. It encompasses the surroundings in which the individual finds himself. The environment is divided into the following sub-divisions: the physical, biological, and social environments. The ecology of disease as described outlined above revolves around the physical environment, the disease causing agent, and the host. The physical environment include climate, atmosphere, water supply and hygiene. The biological encompasses the flora and fauna. The social environment includes the society in which man lives and the psychological attitudes of the family into which the man is born, his education and work. In analyzing the environment, interrelationships exist between the subdivisions of the environment. Environmental factors act on each other. The cause and effect relationship between a given factor and a disease is therefore very complex to establish. Some environmental influences are involved in a "web of causation" (Mead et al, 1989).

The models will try to explain the spread of the disease and the factors that sustained its spread in the guinea worm endemic districts of the Northern Region. The disease diffusion and the disease ecology models will complement each other to explain the reality on the ground.

2.7.3 The Hybrid Conceptual Framework of Disease Diffusion and Disease Ecology

The hybrid conceptual framework of disease diffusion and disease ecology which is molded after Haggerstrand (1968) and Mead et al's (1988) concepts of diffusion has been put together to explain the spread of disease over space and how barriers can be introduced to break the chain of transmission of the disease to humans. In Gregory's (2000) view "the spread of phenomena over space and through time" could be vigorously accepted or, the acceptance of the innovation could meet resistance. In some respects the phenomena could be rejected after having succeeded in making an appearance on the adoption surface.

Information on phenomena could be received with approval by meeting some sort of resistance which could result in the idea being refined to assume a much more acceptable form. The resistance that results from the innovation that occurred becomes a restraining force to regulate the flow of ideas from the mean information field unto the adoption surface where ideas are implemented. In a similar way the nature of interaction for the implementation of innovative ideas can be moderated by the effects of barriers to regulate the spread of an innovation on an adoption surface.

The hybrid conceptual framework of disease diffusion and disease ecology sought to suggest that diseases spread in a community because resistance to it in the form of information flow is limited; and so the barriers to regulate people's conduct at the adoption surface are not effective. However, with increased knowledge on a disease there will be resistance to the disease by strengthening an afflicted people's resolve to build the necessary social and

cultural barriers to regulate their interaction at the adoption surface. It is within these contexts that the disease made its entry into affected communities in Ghana and measures were taken to break the chain of transmission of the disease to humans (Gross, 2014; Taylor et al, 2001).

In this conceptual framework of disease diffusion and disease ecology, the flow of information occurs in between the transmission cycle and the triangle of disease ecology. The human host either has access or no access to information. Information flows from the social milieu of the transmission cycle to the human host. Resistance is created based on the human host's response to the information they have received. The processed information results in shaping responses and attitudes of the human host towards the biological agent of a disease. The physical environment in turn ensures the local survival and subsequent transmission of a disease to cover wider geographic space. Similarly, available information on how to overcome a disease will cause corresponding acceptance at the intervention level to prevent the local survival of a disease and thus terminate its transmission over wider geographic space.

A host of biological, physical, and social factors act together to ensure the local survival, and spread of the disease in a community. In the triangle of disease ecology is the agent-host-environment factor relation. The agent-host factor relation is the intermediate factor that makes it possible for an infection to occur. That is, the way in which the physical environment may permit the infectious agent to thrive and how the culture of a people may expose them to the infectious agent in the physical environment. The host to host factor relation is the final stage of the man-physical environment relationship that may permit an infectious agent to enter and survive locally in a community, or be prevented from coming into contact with people in the community.

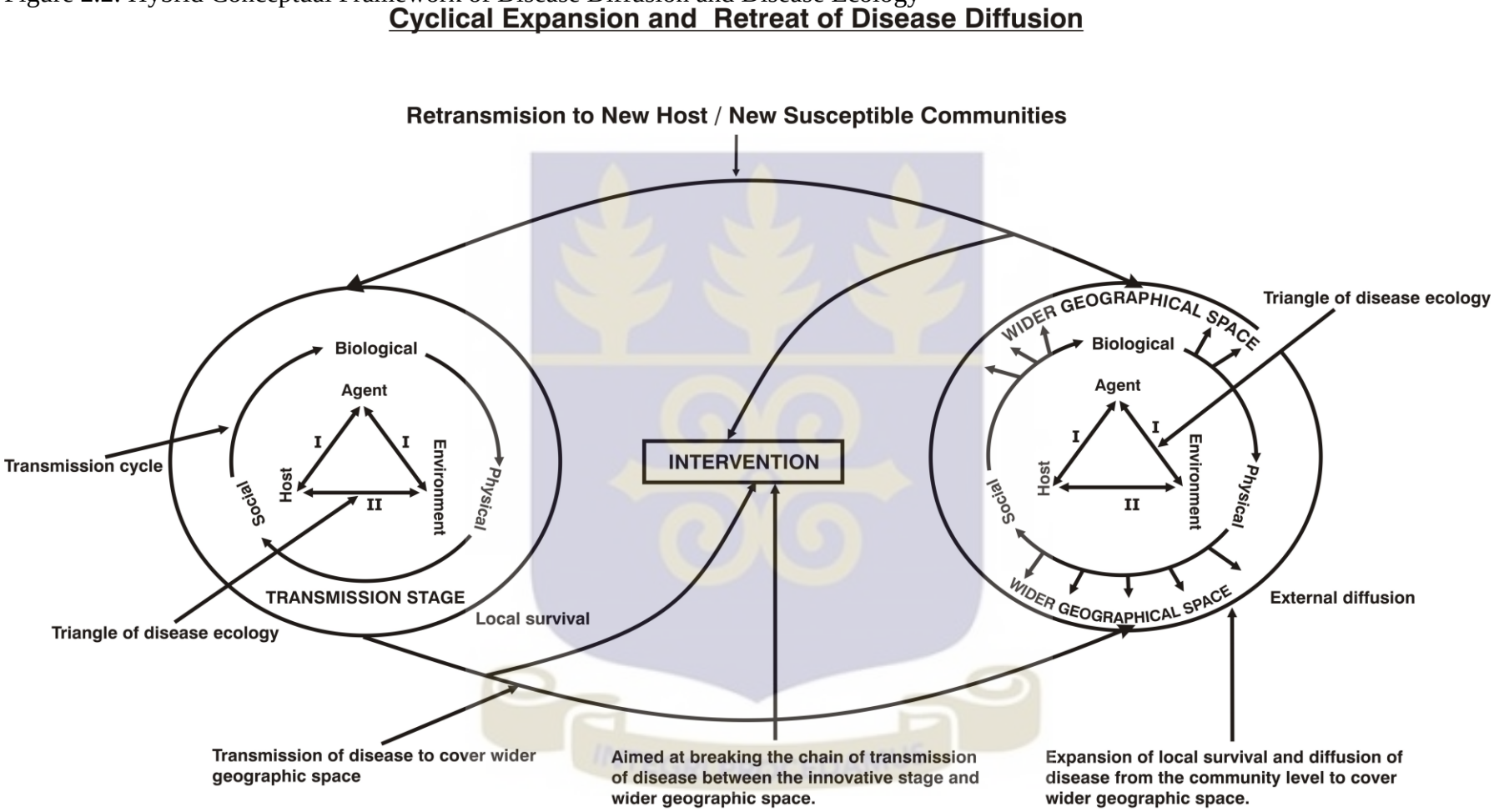
When an infectious agent survives locally, it may then have the chance of spreading beyond the borders of the "innovative" communities to cover wider geographic space. The external diffusion of the infectious agent results in the retransmission of the disease to "innovative" communities. It is in between the cycles of external diffusion to cover wider geographic space and retransmission to innovative communities that interventions can be introduced to break the chain of transmission between the innovative stage of the disease and diffusion of the disease to cover wider geographic space. The hybrid conceptual framework of disease diffusion and disease ecology is shown in Figure 2.2.

In this conceptual framework, a disease spreads to cover wider geographic space by surviving at the individual level in a community. Survival takes place as a result of the individual, in executing social interactions with the physical environment, coming into contact with the biological or infectious agent of the disease. The individual at the community level after having come into repeated contacts with the biological agent of the disease exposes other community members to the danger of being infected with the disease. The disease progresses from the individual level to cover wider geographic space when another member of the community gets infected with the disease. Uncontrolled social and physical interactions with the environment then sustains the continuous spread of the disease to affect many more people in the local community, and other geographic areas, resulting in a vicious cycle of reinfecting the biological agent of susceptible communities and the subsequent spread of the disease to cover wider geographic space. When the life cycle of a disease causing agent is known, steps can be taken to break the chain of transmission of the disease to humans. This can be done by establishing the points at which humans come into contact with the biological agent of the disease. The chain of transmission of the disease can then be interrupted by

modifying people's social interactions with their physical environment and the biological agent of the disease.

If the practices discussed above are adhered to, it would be possible to achieve the ideal situation of Uzbekistan when GWD was eliminated, which is the non-return of guinea worm infections even though majority of the rural areas may not have access to potable water. The overall implication of such a situation would mean that the programme has succeeded in segregating agent-host factor relationships of the biological, physical, and socio-cultural factors of the triangle of disease ecology into their respective environments by controlling the way people relate with the biological and physical agents and hosts of the disease.

Figure 2.2: Hybrid Conceptual Framework of Disease Diffusion and Disease Ecology



Source: Author's Construct derived from Lucas and Giles (1973) and Stock (1976)

CHAPTER THREE

STUDY AREA AND METHODOLOGY

3.1 Introduction

The study area and the methodology that guided the research were discussed along the following thematic areas: geographic layout, area, and population; hydrology and hydrogeology; culture; and, methodology.

The geographic layout of the study area with respect to other administrative districts was outlined. Additionally, the area of land occupied by the study area by districts and cultural groups who inhabit the study area and were affected by the disease were discussed. The population of the study area with respect to administrative districts was highlighted.

Closely related to the research is the water resource potential of the study area. This made it necessary to outline the hydrological (earth surface water) and hydro-geological (water under the ground) potential of the study area.

The geographical distribution of cultural groups in the Northern Region and in the study area in particular was outlined to unearth patterns of technology, ways of producing food, political and economic systems, religious beliefs and rules of behavior that may have contributed to the presence or absence of the disease, and to its eradication.

The sources of data that were used for the research were secondary and primary sources. Chief among the secondary sources of data was the population and housing census records of the study area. Primary data were obtained from field interviews and discussions. Open and close ended questionnaire were used to gather data from respondents and opinion leaders. Focus Group Discussions (FGDs) were held for each cultural group. Each ethnic group had

two focus groups, with members of each focus group being only male or female. Spatial methods for processing data were used to analyze and present data. The results were presented under the dominant ethnic groups or administrative districts of the endemic area.

3.2 Study Area

For the purpose of the research the study area was defined as that part of the Northern Region in which GWD was endemic. Figure 3.1 and Figure 3.2 gives a diagrammatic representation in regional context of the districts in which the disease was found. The geographical area that the endemic districts covers is approximately 30285 sq Km and has a population of 1 137 244 (Ghana Statistical Service, 2011).

A careful examination of Figure 3.1 and 3.2 revealed that guinea worm as a disease and as an epidemic was endemic among the following ethnic areas in the Northern Region of Ghana:

(i) all of Dagomba Traditional Area except Tamale Municipal
(ii) parts of Gonja Traditional Area
(iii) all of Nanumba Traditional Area
(iv) portions of Konkomba Traditional Area, and
(v) Chekosi Traditional Area.

Table 3.1 and Figure 3.3 show the population distribution and the levels of endemicity of the disease in the endemic districts of the region (2010 Population and Housing Census of Ghana). It was seen that the Savelugu-Nanton district has the highest population density and harboured the disease at hyper endemic levels. This district occupies approximately 6.6% of the area in the region in which the disease was endemic and holds about 10.2% of the area's population. The disease existed at hyper endemic levels of endemicity.

Figure 3.1: Study districts in Regional Context

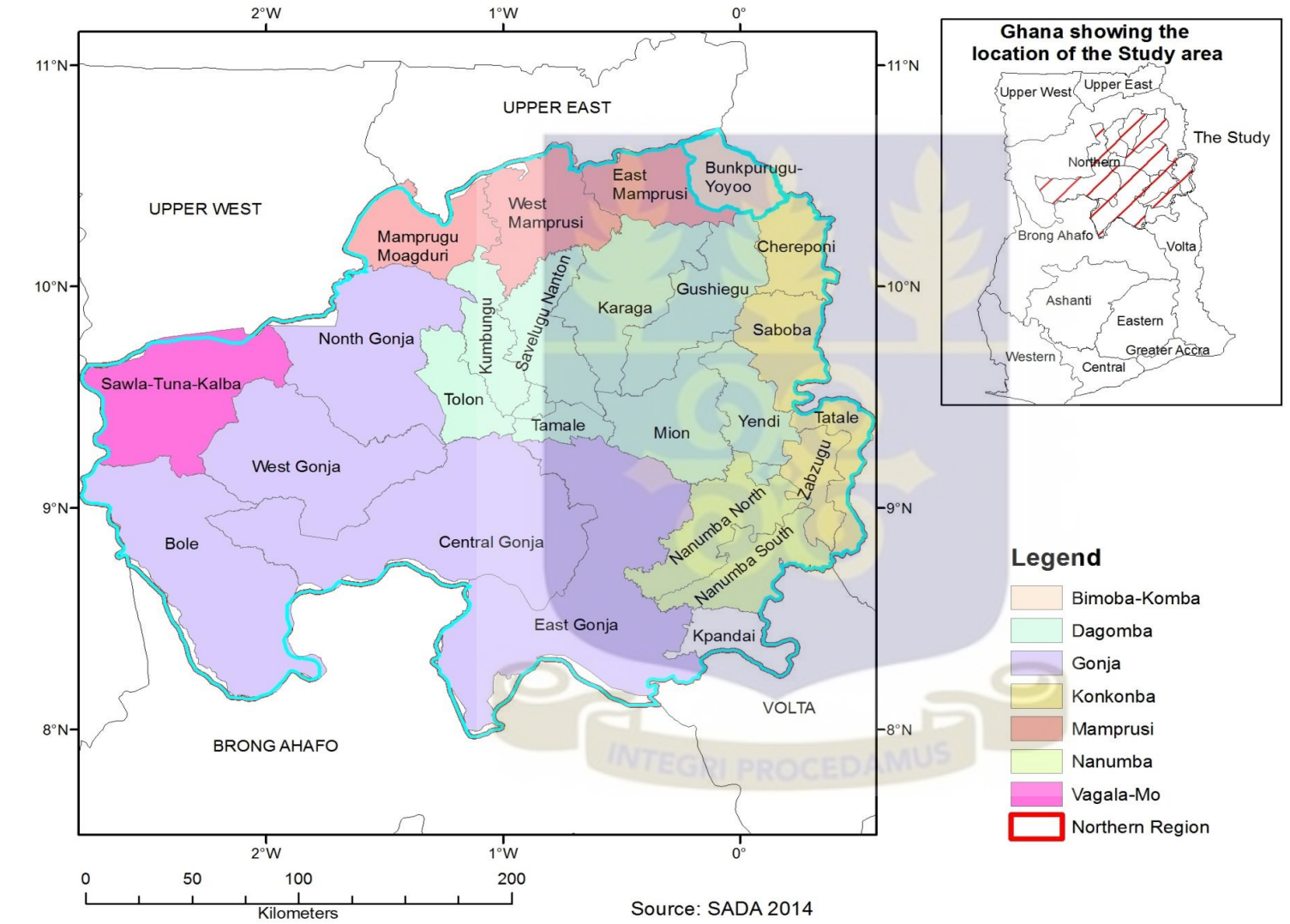
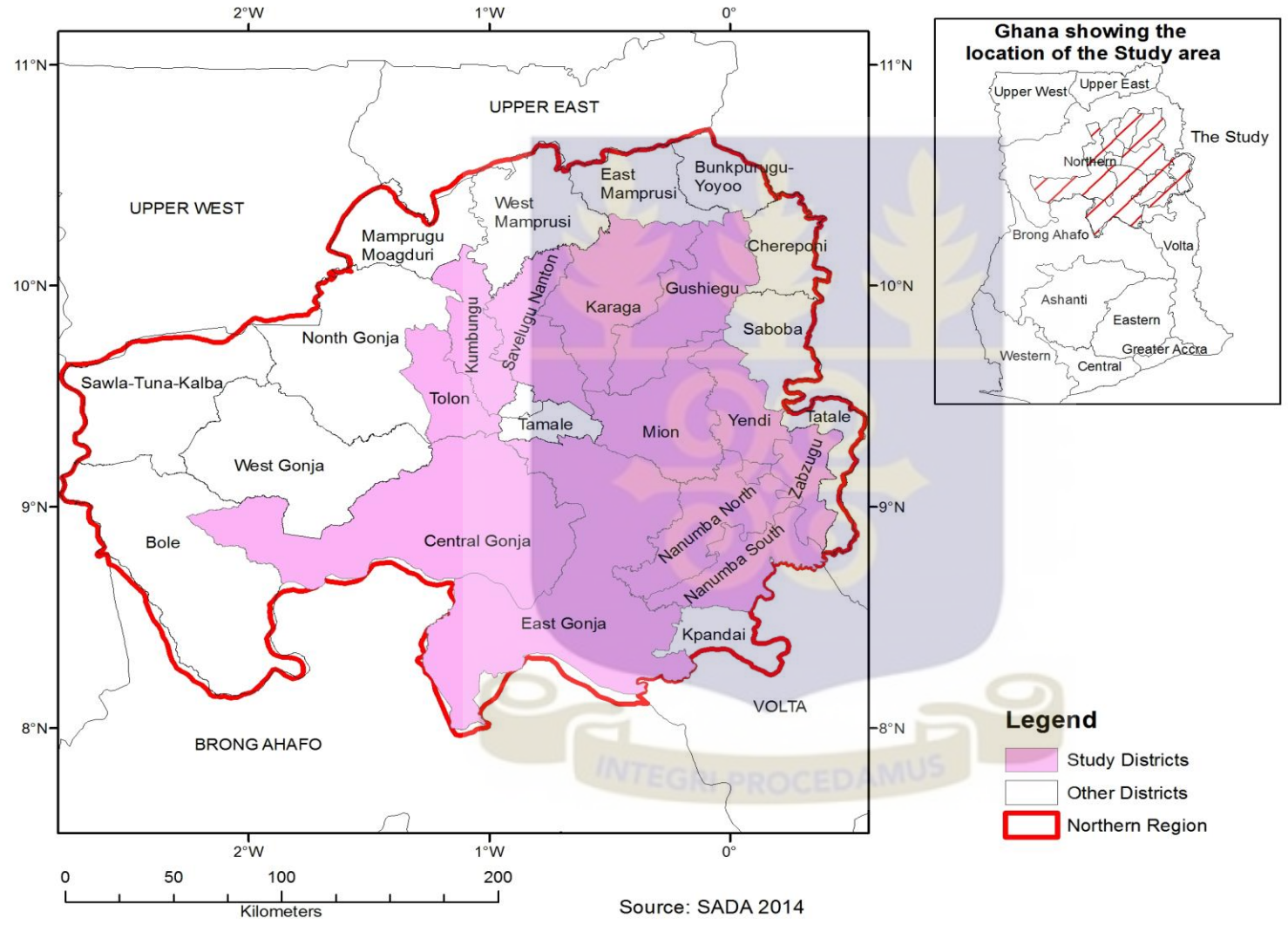


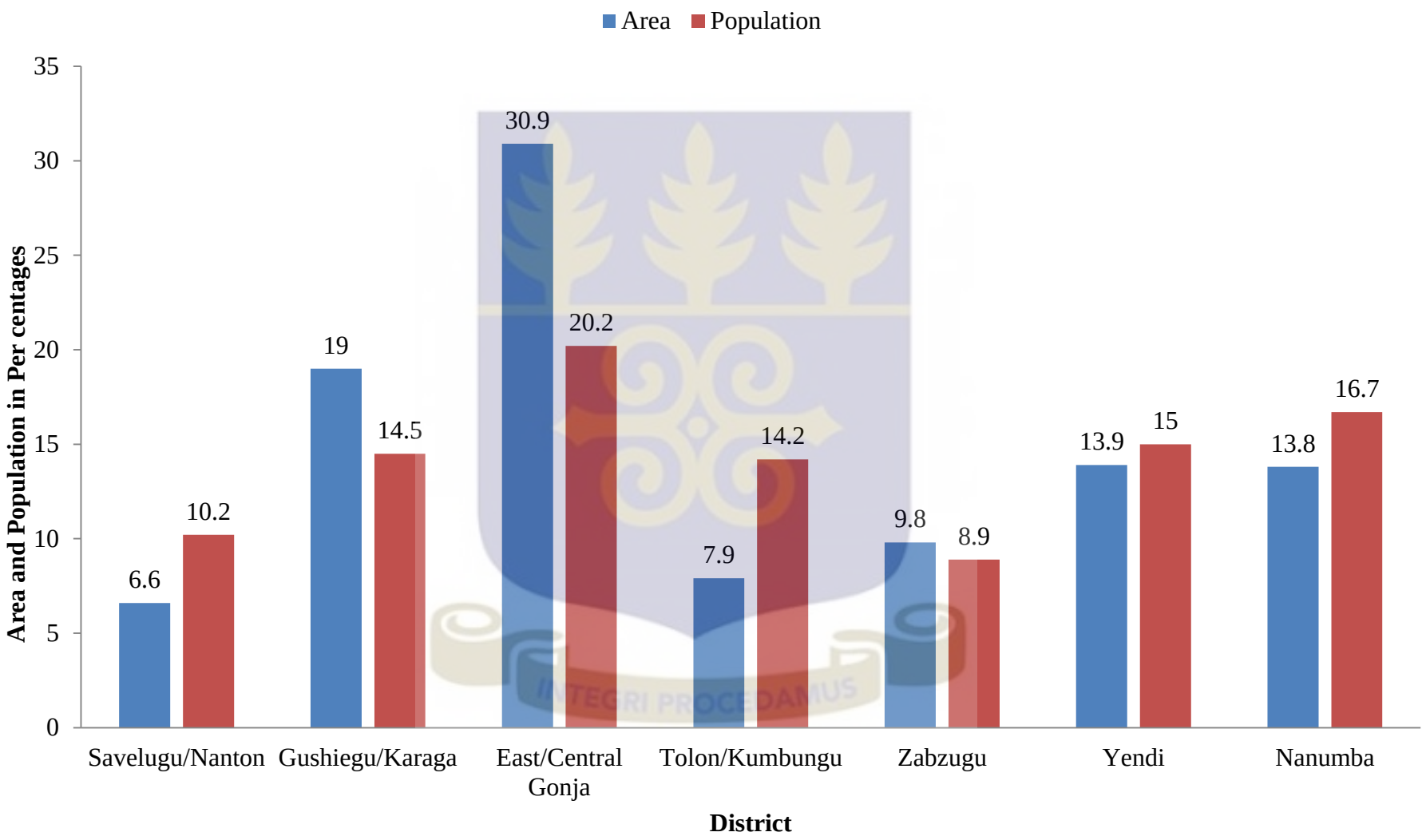
Figure 3.2: Study Areas (Districts) in Regional Context



The East and Central Gonja Districts take up about 30.9% of the endemic area; it also holds about 20.2% of the endemic area's population. The disease prevailed in the East Gonja District at the hyper endemic level, and existed in the Central Gonja District at meso endemic levels (1984 Population Census of Ghana, 1989; 2010 Population and Housing Census; GeoHive 2000-2010 with the support of Ghana Statistical Service). The remaining six districts cover an area of 7.8% and 19% of the endemic area, and keeps between 9% and 15% of the population in each endemic district. These six districts, haboured the disease at meso endemic levels (1984 Population Census of Ghana, 1989; 2010 Population and Housing Census; GeoHive 2000-2010). Even though these districts were designated as the major endemic foci of the disease, other districts in the Northern Region had scattered reports of official cases of guinea worm infections. Notable among these districts were the Bole, Kpandai, Tamale, West Mamprusi, Chereponi and Saboba districts. The occurrence of reported cases of guinea worm infections in the Tamale and West Mamprusi districts are considered to be imported cases of guinea worm infections from other parts of the region and the country.

Figures 3.1 and 3.2 constituted the bedrock for examining data with respect to the following geographical spaces: the administrative districts in which GWD was endemic; and the cultural landscapes within which these administrative districts are found. The administrative district was found useful because it was the medium through which data were obtained, and analyzed to determine the social infrastructure that influenced the prevalence of the disease in the region. The region was used because districts occupied culturally bounded areas which possessed some sort of unity (Gregory, 2000), through which order was imposed on data to unearth the possible cultural influences that contributed to the spread of the disease and to its subsequent eradication.

Figure 3.3: Distribution of Population by District within Guinea Worm Endemic Areas



Source: 1984 Population Census of Ghana; 2010 Population and Housing Census

3.2.1 Ethnic occupation of study area by districts

With respect to the geographical spread or settlement of the Northern Region by ethnic groups the Dagombas are in total occupation of 5 districts and co-exist with the Konkomba in 2 districts. Next are the Gonjas who are in total occupation of 4 districts. The Nanumbas come third by totally occupying 2 districts and co-exist with the Konkomba, the Dagomba, and the Chekosi in one district. Closely following the Nanumba are the Konkomba who totally occupy one district and co-exist with the Dagomba in one district, and with the Nanumba, the Dagomba, and the Chekosi in another district. These are followed by the Mamprusi who totally occupy two districts. The Basaari and the Nawuri are in total occupation of a district each. The Bimoba partially occupy one district; they coexist with the Komba. The Mo partially occupies one district; and share the space with the Vagala. Figure 3.2 is an ethno-cultural map of the Northern Region of Ghana. From Figure 3.2 it is observed that the study area covers all of Dagomba Traditional Area, except Tamale Municipal; parts of Gonja Traditional Area; all of Nanumba Traditional Area; portions of Konkomba Traditional Area; and, all of Chekosi Traditional Area.

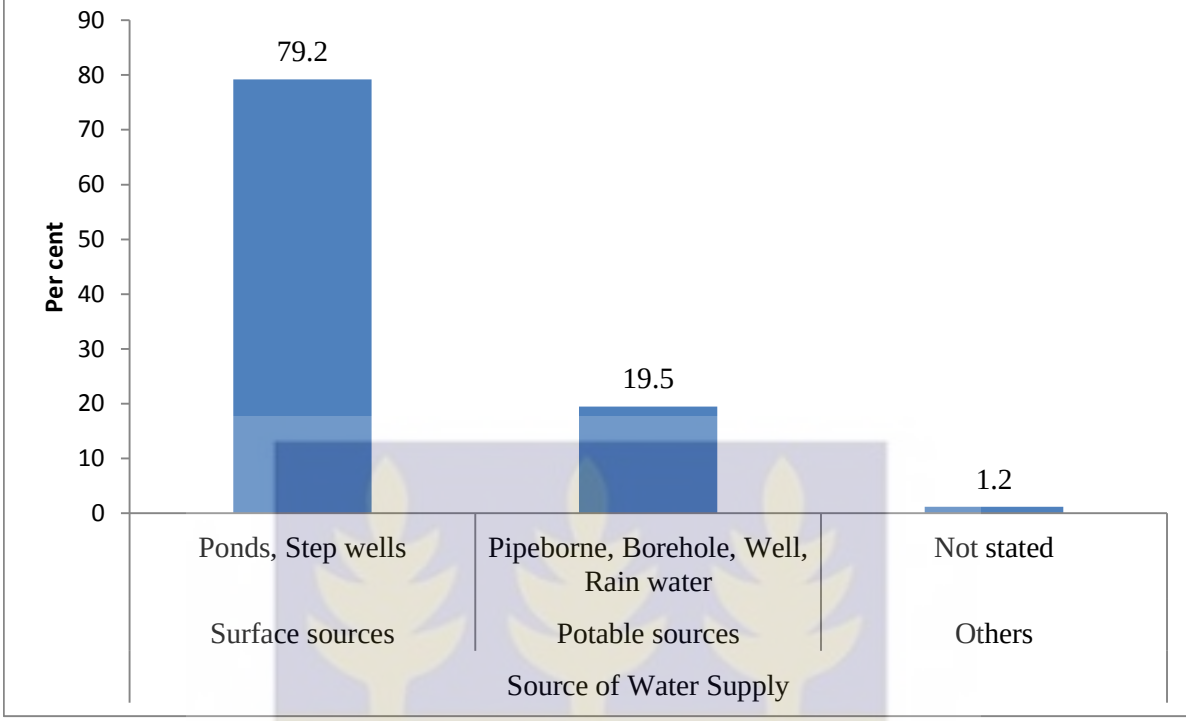
3.2.2 Sources of water supply in the Northern Region

The sources of water supply in the Northern Region before the GWEP was started were as follows: pipeborne water, boreholes, wells, rainwater, and open water bodies. It was observed that the leading source of water supply prior to the onset of the programme was open water bodies, with an average regional dependence of 75.6%. Next in line was water from wells, which accounted for an average regional dependence of 16%. Pipe borne water came third with its average regional dependence as 6.3%. Boreholes and rainwater came last with average regional dependencies of 2.5% and 1.2% respectively. This situation followed the same pattern in the guinea worm endemic districts in the region. The people in most of these areas did not practice a sophisticated regime of fetching water from their unsafe sources of water supply. However, a cursory glance at the map in Figure 3.4 suggests that the provision

of government water supply facilities (pipe borne water and boreholes) during this period was woefully inadequate.

It was observed that the major source of drinking water for the people of the Northern Region of Ghana during the pre-eradication period was surface sources of water supply. They were mostly dams, dugouts, ponds, step wells, springs, rivers, and canals. Despite this disadvantage the Northern Region of Ghana also had quite a reasonable supply of potable water. This water was provided by boreholes, wells, and pipe borne sources. During the pre-eradication period it was possible to come across broken down boreholes that would take some time to restore. Also piped borne sources of water supply which came in the form of town and community standpipes were known to flow on specific days of the week and for a given time period. It was common practice during those days for taps to flow between 4 am and 9 am. This meant, households did not always have sufficient water, especially during the dry season when the supply of water through standpipes was irregular. This left people with only one source of reliable water supply during the dry season. This was water from wells. The water levels of wells during the dry season were known to drop so low as to dry up because the rate of drawing water from them exceeded their capacities to replenish themselves. In the wake of this cycle of periodic abundance and scarcity of potable water between the wet and dry seasons it was quite easy to understand why people in the towns and villages in the Northern Region were caught in the web of relying on sources of drinking water that was largely unsafe.

Figure 3.4: Water Supply in Northern Region before GWEP, 1984



Source: Field Data, May 2012

Plate 1: (A) Surface sources of drinking water, Northern Region

(B) Shallow well in dry river bed (C) Damaged borehole

Source: Field Data, April 2015

Surface sources of drinking water which include dams, ponds, dugouts, step-wells, and rivers were the major source of water supply to the communities in the guinea worm endemic districts of the Northern Region of Ghana before the GWEP was launched in 1989. It was this source of water supply that exposed the people in the guinea worm endemic districts of the Northern Region of Ghana to the biophysical agent of the disease as explained in the triangle of disease ecology in Figure 2.2.

3.3 Methodology

3.3.1 Data sources

The sources of data that were relied on for the research were secondary and primary sources. Secondary sources were examined to establish the reference point of the availability of sources of water supply and the level of severity of the guinea worm epidemic in the Northern Region of Ghana before the GWEP was implemented. Primary sources were relied on to determine the situation of the guinea worm epidemic after the GWEP was implemented.

3.3.2 Secondary sources

Secondary data from the following sources were used to conduct the research:

The sources of water supply in the 1970, 1984, 2000, and 2010 Population and Housing Census records of Ghana for the Northern Region of Ghana were relied on to build the case on the provision of potable water and unsafe sources of water supply. With respect to the 2000 and 2010 Population and Housing Census records data had to be obtained directly from the Ghana Statistical Service.

Health records from the district health directorates and health centres and the GWEP head office in Tamale were consulted for details on the guinea worm epidemic, and the progress the GWEP made in the region. Records from the WHO Collaborating Centre for Research, Training and Control of Dracunculiasis (Guinea worm-wrapup) and the Annual Reports of the Global 2000 Inc. of the Carter Presidential Center on the disease were consulted to

determine the point at which this research will be of benefit to society and make an original contribution to knowledge.

3.3.3 Primary Sources

Primary data was obtained from the administration of questionnaire, Focus Group Discussions, an interview with a key informant, and discussions with opinion leaders.

3.4 Methods of Data Collection

3.4.1 Focus Group Discussion

Each administrative district had two focus groups. One was devoted to male and the other to female participants. All participant were 18 years and above. Each group had an equal number of 12 participants. These groups were restricted to their specific genders to enable members express themselves freely. The themes discussed were ways in which the epidemic affected people, health situation before the GWEP, how effective the programme was, contribution of the programme to health and socioeconomic wellbeing, and ways in which the programme changed peoples' behaviour towards the disease and their environment.

3.4.2 Opinion Leaders/Key Informant

Community members who witnessed the epidemic and the situation of the epidemic after control measures were instituted by the programme were also interviewed. They include community headmen, elderly people, other traditional community leaders, assembly men, unit committee members, and influential volunteer village workers of the programme. The first National GWEP Coordinator, who became the Chairman of the National Guinea worm Certification Committee (Dr. S.Z. Bugri) was relied on as a key informant for in-depth information on the guinea worm epidemic and the GWEP.

3.4.3 Questionnaire Administration

The study area comprises 11 administrative districts. The sample population for each district was proportional to the population for that administrative district. The 2010 Population and Housing Census record for the study area was 1 137 244, constituting approximately 46.1% of the Northern Region's population. To achieve a representative distribution of questionnaire

respondents' were proportionately distributed according to the population of each administrative districts of the study area. The detailed outline of the sample populations are shown in Table 3.1 and 3.2. A 0.1% sample size of the 2010 population and housing census was 860.

Two sets of questionnaire were administered. The first, a set of 860 questionnaire was administered to household heads/other residents and opinion leaders to obtain information on the guinea worm epidemic and the effect the GWEP had on socio-economic development. The second set of 300 was administered to residents to test the research hypothesis.

Table 3.1 Sample population of endemic areas by administrative districts and respondent categories

ADMINSTRATIVE DISTRICT	SAMPLE POPULATION	DIST. PER CENTAGE OF SAMPLE POPULATION	RESPONDENT CATEGORY	NO OF RESPONDENTS	PERCENTAGE
Yendi	155	18	Household heads	128	14.9
			Opinion Leaders	27	3.1
Savelegu-Nanton	95	11	Household heads	80	9.3
			Opinion Leaders	15	1.7
East Gonja	94	10.9	Household heads	82	9.8
			Opinion Leaders	12	1.4
Central Gonja	58	6.7	Household heads	49	5.7
			Opinion Leaders	9	1
Zabzugu-Tatale	88	10.2	Household heads	73	8.5
			Opinion Leaders	15	1.7
Nanumba North	49	5.7	Household heads	41	4.8
			Opinion Leaders	8	0.9
Nanumba South	73	8.5	Household heads	64	7.4
			Opinion Leaders	9	1
Gushiegu	70	8.1	Household heads	59	6.9
			Opinion Leaders	11	1.3
Karaga	66	7.7	Household heads	58	6.7
			Opinion Leaders	8	0.9
Tolon	45	5.2	Household heads	39	4.5
			Opinion Leaders	6	0.7
Kumbungu	67	7.7	Household heads	59	6.9
			Opinion Leaders	8	0.9
Total	860	100		860	100

Source: 2010 Population and Housing Census Provisional Results.

Table 3.2: Sample population for hypotheses test

ADMINSTRATIVE DISTRICT	SAMPLE POPULATION	PER CENT
Yendi	46	15.3
Savelugu-Nanton	31	10.3
East Gonja	30	10
Central Gonja	30	10
Zabzugu-Tatale	27	9
Nanumba North	25	8.4
Nanumba South	25	8.4
Gushiegu	22	7.3
Karaga	22	7.3
Tolon	21	7
Kumbungu	21	7
Total	299	100

Source: 2010 Population and Housing Census Provisional Results; GeoHive, 2000

Household heads and opinion leaders in the endemic districts were randomly selected and interviewed to determine how the epidemic affected people and their respective communities and how the programme affected the socio-economic development of the people and their respective communities. The fourth objective sought to test the hypotheses of the research.

Considering the volume of questionnaire that was to be administered within a short space of time over the entire guinea worm endemic area of the Northern Region field staff were hired to assist in the speedy administration of the questionnaire, and holding Focus Group Discussions. In this regard the research was recover 860 of the first set of questionnaire. There was however 100% recovery of the second set which was administered to address the fourth objective aimed at testing the research hypotheses.

With regard to Focus Group Discussions every district was fully represented with respect to the various groups that were identified for the purpose of obtaining qualitative data to enliven the quantitative aspect of data that were obtained. One respondent granted an interview on the antecedents of the epidemiological aspect of the disease and the political and institutional

factors that influenced Ghana's national effort to join the global initiative to work towards eradicating the disease in 1986, 1988, and 1989 (Bugri, 1993).

3.5 Data Analysis and Presentation

The data of the research was analyzed using two major themes. They were the spatial and the ethnic themes. The data could have been analyzed using gender considerations, or educational backgrounds, or age cohorts, or marital status; but the functional theme (Gregory, 2000) and ethnic themes (Cosgrove, 2000) were chosen above the rest because they were found to be themes under which order could be imposed on the data to achieve meaningful observable patterns. This option for analyzing the data was used because explanations of observable patterns on the effects of the GWEP were influenced by cultural factors and national institutional factors.

The spatial categories for analyzing the data were the administrative region which was the Northern Region of Ghana or the administrative districts that are located in the Northern Region of Ghana. In this regard the spatial analysis presented some challenges because new administrative districts were carved out of existing ones between 1970 and 2010. The challenge became more pronounced with the creation of the most recent administrative districts in which some administrative districts prior to the 2000 and 2010 creations were considered guinea worm endemic districts; but with the creation of new districts they are no longer considered as guinea worm endemic districts. For example, the Salaga district which comprising of parts of the Gonja area, the Nanumba area, and Kpandai area was considered a guinea worm endemic district when the programme was launched in 1989. But between 1992 and 2010 new districts were carved out of the Salaga district to create the East Gonja district, the Nanumba North district, the Nanumba South district, and the Kpandai district. Kpandai which used to be part of the Salaga district, thus making it a guinea worm endemic area, was no longer considered a guinea worm endemic area.

However, there was the need to capture some aspects of the analyzed data according to administrative districts because it was not suitable to present them under the cultural or ethnic theme of analysis. For example, the availability of sources of water supply that was considered to have influenced the spread of the disease and the subsequent eradication of it could not be attributed to ethnic factors.

Variables were grouped into respondent category, age, sex, education, occupation, district and ethnicity was to determine respondents' views on the factors which influenced the spread of the guinea worm epidemic, those which influenced the eradication of the disease, and the effects the GWEP had on socio-economic development in the study area.

Data was analyzed and presented with the aid of:

i. Maps;
ii. Statistical methods, using cross tabulation, Pearson's chi square test, descriptive statistics, and tables;
iii. Graphs, including bar graphs, column graphs, line graphs; and,
iv. Venn diagrams.

CHAPTER FOUR

THE EPIDEMIOLOGY OF THE GUINEA WORM DISEASE IN THE NORTHERN REGION OF GHANA

4.1 Introduction

This chapter gives a summary of the demographic profile of respondents interviewed in the study area and addressed the first objective of the research; namely, "examine the epidemiology of GWD in the Northern Region"; and the first proposition of the research which was "guinea worm infections were restricted to hyper endemic foci of the disease in the Northern Region of Ghana". In this regard the factors responsible for the rapid spread of the disease in the Northern Region of Ghana were examined. The epidemiological factors as embodied in the hybrid conceptual framework of disease diffusion and disease ecology of the conceptual framework of the research were identified as the biological, physical, and social factors that acted together to ensure the local survival and spread of the disease in the former guinea worm endemic communities of the Northern Region.

In furtherance of the objective of examining the epidemiology of the disease an attempt was made to find out if there was a relationship between the geological and hydro-geological character of the area and the availability of potable water. The research therefore examined the hydro-geological and fluvial geomorphological character of the Northern Region of Ghana. In addition to this the research took a look at the hydrogeology (groundwater) and the geological processes that probably influenced the availability of potable water.

The culture of the ethnic groups in the Northern Region was examined to find out how their patterns of behaviour and thinking influenced them to create and share practices that probably contributed to the extensive spread of the disease in the guinea worm endemic areas of the study area. This was done by discussing the beliefs, rules of behaviour, rituals, and

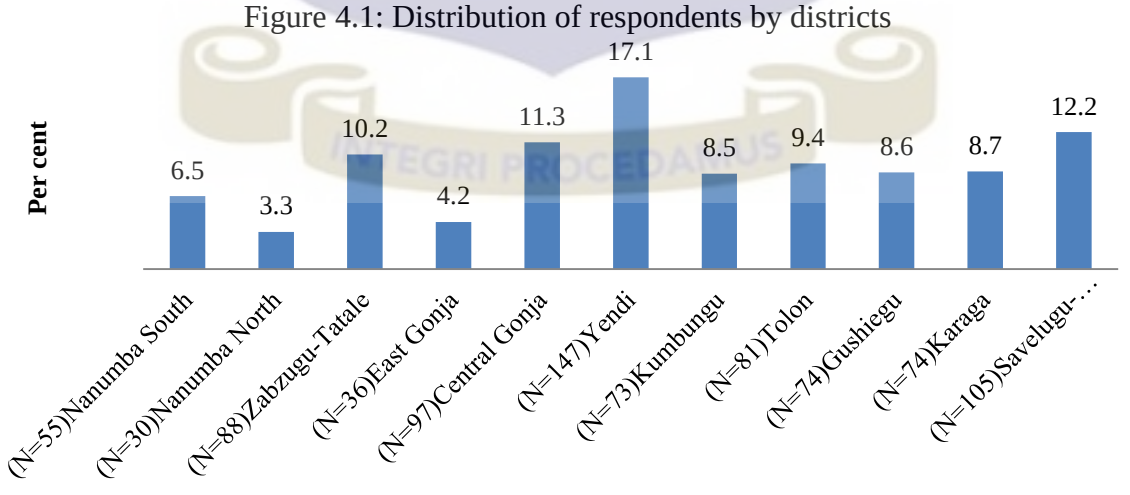
technology (Bodley, 2009) of ethnic groups which may have contributed to the number of guinea worm cases rising to epidemic levels over a specific geographical area in the Northern Region. The major ethnic groups that were considered to be representative of the region for the purpose of the epidemiological examination were the Mamprusi, the Dagomba, the Gonja, the Nanumba, and the Chekosi.

The epidemiological aspect of the disease was introduced to meet evaluation and decision making problems. The added purposes for the introduction of the epidemiological aspect of the disease was to anticipate the socio-economic and ecological effects of large scale disease eradication programmes; and, to forecast trends for operational decisions to be made.

4.2 Demographic characteristics of respondents

This section described the demographic profile of respondents in the study area. A total of 860 completed questionnaire, administered to household heads/residents and opinion leaders was recovered from the study area. Responses were open ended were entered on SPSSv20 to generate the frequencies, cross tabulations, and chi-square tests. Figure 4.1 shows the distribution of respondents by endemic districts of the disease in the Northern Region.

Figure 4.1: Distribution of respondents by districts

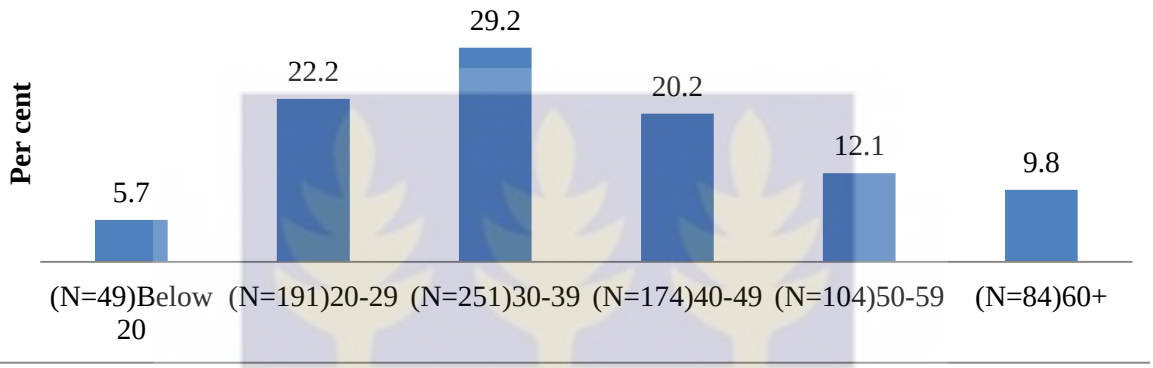


Source: Field Data, September 2012 – January 2013

From Figure 4.1 it was realized that Yendi had majority of respondents answering the questionnaire. The Nanumba North district had the lowest mumber of respondents. The rest

of the districts had between 6.5% and 12.2% of respondents. Respondents from East Gonja were more than those from the Nanumba North district and considerably below the lowest of the general majority and so were classified separately from them. Of respondents interviewed in Figure 4.1, majority were household heads/residents, with the rest being opinion leaders.

Figure 4.2: Distribution of respondents by age



Source: Field Data, September 2012 – January 2013

The distribution of respondents as shown in Figure 4.2 was between the ages of 18 and above 60 years. Majority (83.7%) were between 20 and 59 years with those below 20 years and above 60 years forming the minority (15.5%).

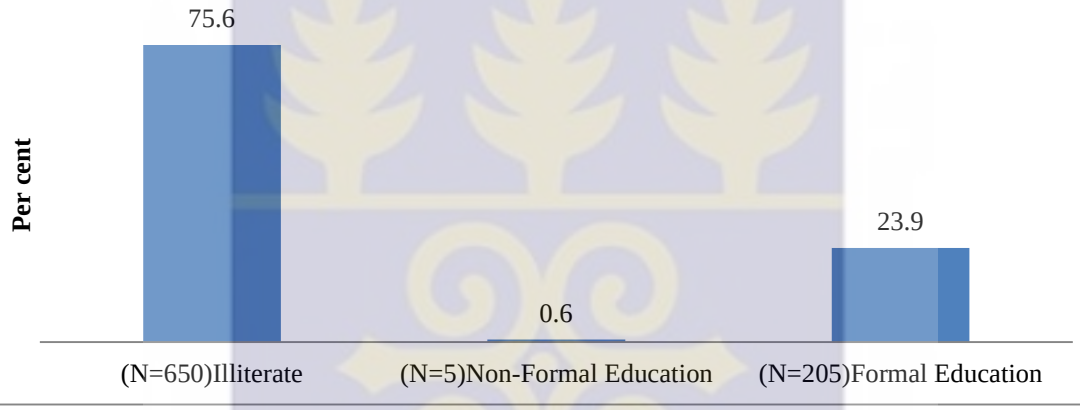
With regard to the distribution of respondents by sex, majority (71%) were male, whilst the rest (29%) were female. This was obvious because household heads were the majority in which it is a known fact that males are the heads of households in the study area.

The dominance of males over females in the sample population presented the problem of gender bias in favour of males with respect to the opinion of respondents. However, this was catered for by holding Focus Group Discussions which were restricted to gender specific focus groups. This was to ensure a fair representation of the opinions of females by infusing

gender specific qualitative data into the quantitative data which had a lower representation of females with respect to male respondents.

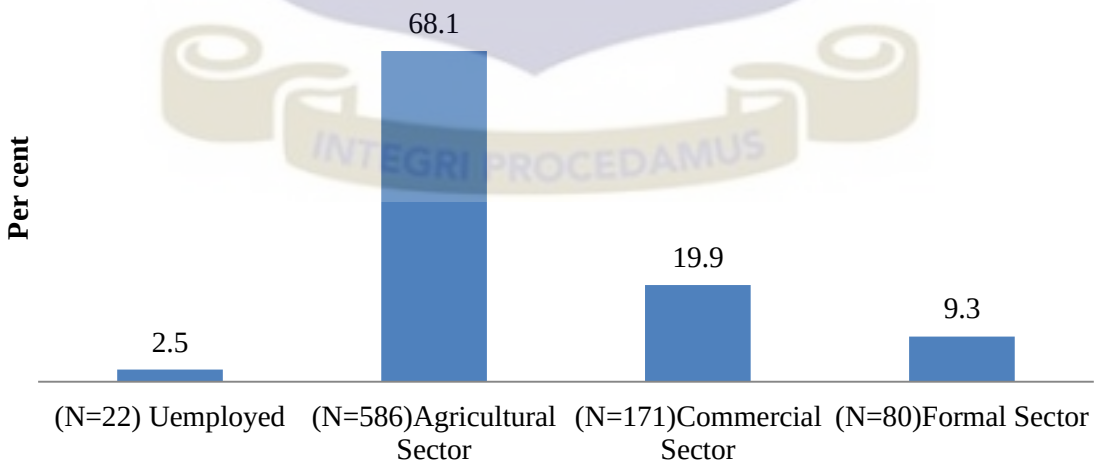
The educational profile of respondents was examined in Figure 4.3. The different categories that were used to determine the educational profile of respondents were illiterate, non-formal education, and formal education. Majority of respondents were illiterate (75.6%) while resondents who benefitted from some form of formal education were the minority (23.9%).

Figure 4.3: Educational characteristics of respondents



Source: Field Data, September 2012 – January 2013

Figure 4.4: Occupational characteristics of respondents



Source: Field Data, September 2012 – January 2013

Figure 4.4 examined the occupational characteristics of respondents and found that those interviewed were either engaged in farming, trading, teaching, or were house wives, civil servants, drivers, artisans, or unemployed. From Figure 4.4 it came to light that 68.1% of respondents were engaged in farming, 19.9% plied some form of trade (fitters, welders, carpenters, weavers, tailors and seamstresses), 5.5% were students, 3.8% were civil or public servants and, 2.5% said they were unemployed.

4.3 A geological examination of GWD in Northern Region

Hydrogeological provinces in Ghana have been determined on the basis of geology. This was found to influence ground water occurrence and availability (Gill, 1969). The major hydrogeological provinces in the Northern Region are the Voltain and the Precambrian Provinces. Table 4.1 indicates these provinces with their corresponding dominant lithologies. An examination of these systems revealed that spatial variability and quality of underground water is influenced by the dominant lithologies in each province (Carrier et al, 2008).

Table 4.1: Lithologies of major geological provinces of the Northern Region

Province	System	Series	Dominant lithology
Voltain Province	Voltain System	Upper Voltain	Massive sandstone, conglomerate with thin beds of shale and mudstone locally
		Middle Voltain	Obosum beds – mudstone, shale, sandstone, conglomerate, some limestone
			Oti beds – Arkose, sandstone, conglomerate, mudstone, shale, limestone
		Lower Voltain	Basal quartz sandstone with pebbly grits and grits
		Buem series	Shale, sandstone, lava and full with some limestone, grit, and conglomerate
Precambrian Basement Province	Tarkwaian System	Huni, Tarkwa, Banket, Kawere	Sandstone, shale, conglomerate quartzite, schist, phyllite
	Birimian System	Granitoid intrusions	Mainly granite, granodiorite, gneiss
		Upper Birimian	Metamorphosed tuff and lava (andesitic basaltic)
		Lower Birimian	Schist, phyllite, slate, with greywacke and sandstone

Source: Carrier et al, 2008

Rocks of the Precambrian Province have low primary porosity and permeability. The most productive area of groundwater in this province is the lower and upper part of the rock. They complement each other in terms of permeability and storage. Ground water control and flow is therefore influenced by secondary porosity. However, the Birimian System in this province is known to yield high quantities of groundwater (Carrier et al, 2008). Hand dug wells are therefore used to exploit shallow aquifers. These wells, however, do not yield water all year round. This causes rural populations to return to non potable sources toward the end of the dry season. To achieve all year round water supply from the Birimian and Tarkwaian systems (Precambrian Basement Province) boreholes are drilled to depths that range from 35 M to 62 M (Agyekum, 2004).

Rocks of the Voltain Province are well consolidated and are impermeable. Ground water in this province occurs and flows in fracture zones and along bedding planes because primary porosity of these rocks was destroyed through compacting of loose deposits into rock, and ground water depositing cementing material to form sedimentary rock. The Voltain system is also unsaturated in many areas and thus provides minor amounts of ground water locally (Acheampong, 1998). This is due to the fact that the regolith of the Voltaian system was found to have stable compositions of clay (shale), quartz (sandstone), or soft unmetamorphosed mudstone which have the capacity to store water but does not readily give up water. Fractured rock aquifers in this province have low to moderate productivity.

On the other hand the middle Voltaian series has within its lithology arkose or arkosic sandstone (Oti beds) which weathers more easily than quartz or clay minerals and so are able to store and give up ground water from shallow perched aquifers. The aquifer in some places have been tapped with shallow hand dug wells.

Because it is difficult to obtain water from the Upper Voltaian and parts of the Middle Voltaian series, depths of boreholes in this province are deeper than those of the Precambrian Basement Province. Boreholes in the Voltaian Province are drilled to depths that range from 45 M to 75 M (Agyekum, 2004). Bore hole depths, because of low transmissivity and high resistivity, have attained depths of approximately 355 M (Carrier et al 2008).

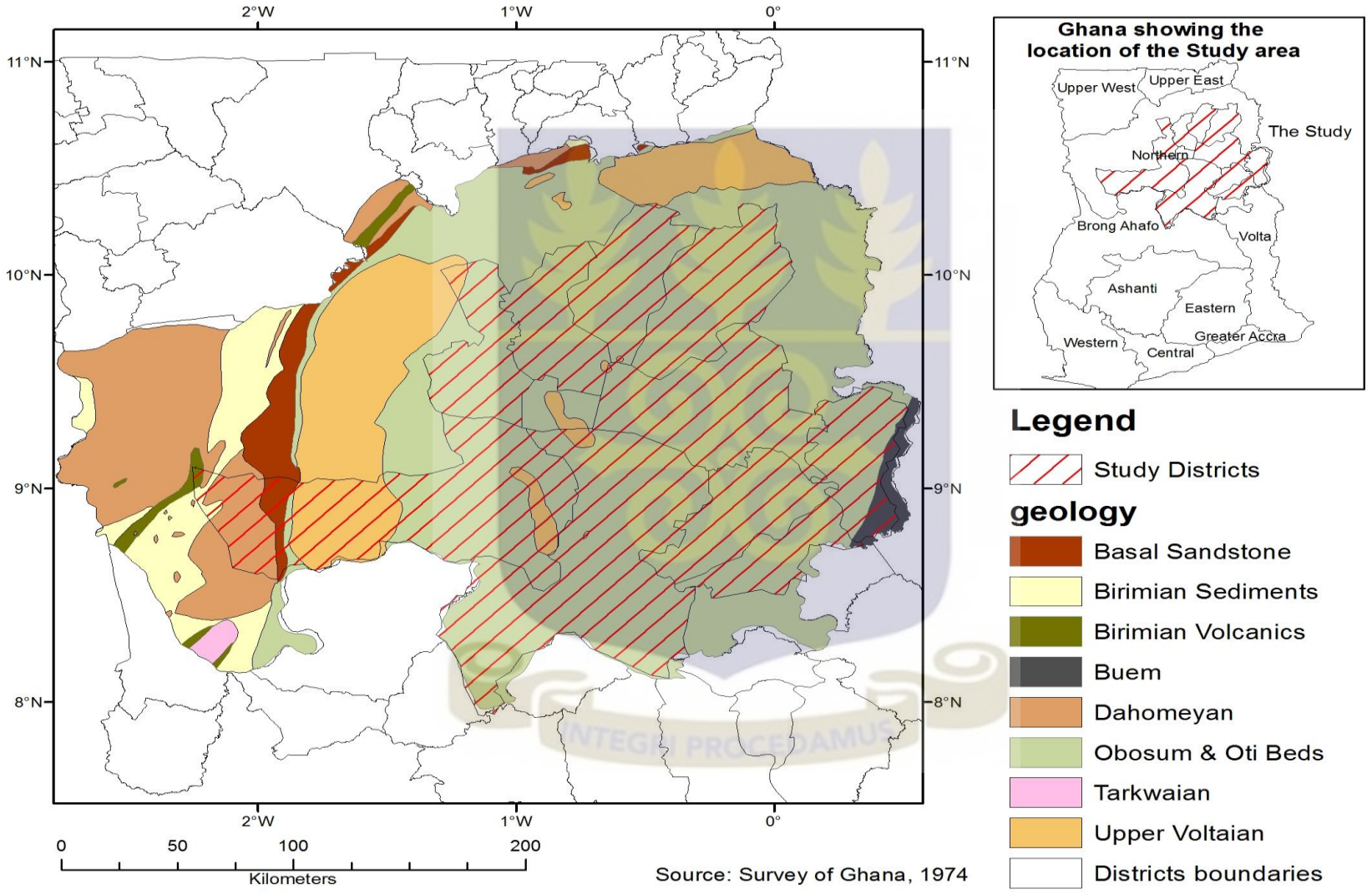
To explain the variability of borehole yields and the low success rate of potable water in the region, Acheampong and Hesse (1998) indicated that "water bearing structures are discrete entities with highly variable production rates." This supports the assumption that ground water occurrence in the region is largely controlled by geologic structures. An examination of the geological map of the region showed that endemic districts are located largely on the Obosum beds of the Middle Voltaian series. Figure 4.5 shows the location of these districts on the Middle Voltaian series of the Voltaian Province. The Obosum beds of this series are unsaturated in many areas and therefore provides minor amounts of ground water locally. Also, this series has in its dominant lithology high quantities of clay which prevents the flow of ground water. This results in high failure rates when bore holes and wells are sunk in these districts.

An attempt was made to see if there was a relationship between the geological structures in the region and the ethnic areas in which the disease was endemic. To do this the research tried to establish a relationship between the dominant lithologies of the geological structures and ethnic groups located on the Upper Voltain and Middle Voltain series of the Voltain Pronvince. The Upper Voltain occurs in most of Mamprusi and Gonja Traditional Areas. The Dagomba area was found to have minor distributions of this series. The Middle Voltain series

was found to cover extensive portions of Mamprusi and Bimoba areas, the entire of Dagomba, Konkomba, and Nanumba Traditional Areas, and extensive portions of Gonja Traditional Area.

As mentioned earlier, ground water of the Upper Voltain Province occurs and flows in fracture zones and along bedding planes. Secondly, the Middle Voltain has in the dominant lithology of its Oti beds, arkose or arkosic sandstone which weathers easily and is therefore able to store and give up ground water from shallow perched aquifers.

Figure 4.5: Geological Map of Northern Region



The Mamprusi, Bimoba, and portions of the Gonja areas are endowed with this geological structure. This has made it possible for them to benefit from shallow wells and a relatively high success rate of sinking high yielding boreholes.

It is difficult to obtain ground water from the Obosum beds of the Middle Voltain series because these geological structures are unsaturated in many areas of the Northern Region, thus providing insufficient amounts of ground water locally. Most of Dagomba, Konkomba, Nanumba and parts of Gonja Traditional Areas are located on this geological structure. This condition makes it difficult for some of the people in these areas to benefit from shallow wells and high yield boreholes.

4.4 The environmental perspective and the cultural context

Having established the geological reasons which account for the presence of GWD in the Northern Region the research found out a set of cultural practices and environmental influences contributed to the occurrence of the disease in the former guinea worm endemic areas of the Northern Region. Similarly, cultural practices and environmental conditions was also found to have contributed to the absence of the disease in areas of the region where the disease was not endemic. An interview granted by a key informant threw light on the cultural practices and environmental influences which contributed to the presence and absence of the disease in different parts of the region.

An interview granted by Dr Sam Bugri, a former Director of the Public Health Division and the first National Guinea Worm Coordinator (Monthly Epidemiological Bulletin, July 2010), revealed there were cultural practices and environmental influences that accounted for the presence of the disease among some ethnic groups and absent in other ethnic groups. He gave three reasons why the disease was prevalent among the Gonja, Dagomba, Nanumba and

Konkomba; and advanced a reason for the absence of the disease among the Mamprusi and to some extent the Bimoba and the Komba.

4.4.1 The environmental perspective

In the Konkomba and Nanumba areas which are located in the south eastern corner of the Northern Region of Ghana, notably in the Nanumba North and Nanumba South districts and in the Zabzugu Tatale area it was observed that people in the area were exposed to guinea worm infections because their major source of drinking water was from surface sources of water supply. The culture of digging wells was absent in these areas because their rivers and ponds are perennial in their supply of drinking water. Underground water was difficult to access because their water tables were so low as to render the digging of wells unproductive. In these communities of guinea worm infections, transmission of the disease was influenced by the relationship of the people to the physical environment. That is having all year round contact with perennial surface sources of water supply as a result of relying on few wells in these areas.

4.4.2 The cultural context

Dr. Sam Bugri noted that the Gonja area had some endemic areas that were provided with boreholes; but the people preferred surface water to underground water of the area because water from some of their boreholes was salty. There was the added problem of underground water being far removed from the surface, making the cost of digging wells prohibitive and unproductive. The people therefore preferred to rely on surface sources of water supply for their drinking water. The relationship between the high saline content of the underground water and the low water table of the former Gonja guinea worm endemic areas which has an extensive spatial distribution in the Obosum and Oti beds and Upper Voltain formation was therefore considered by the research to be inconclusive.

Within the Dagomba area Dr. Bugri intimated that what accounted for guinea worm infections was the people's "knee deep" culture of fetching water. By this he meant there was the erroneous belief in the Dagomba areas that wholesome water was obtained from surface sources of water supply by wading in these sources of water supply to "knee deep" levels to fetch water. It was an indiscriminate contact with open sources of water supply that exposed people in the Dagomba areas to guinea worm infections. Even though all the Dagomba areas that were endemic to the disease are located on Obosum and Oti beds, there was no evidence of the people of the former guinea worm endemic areas of Dagomba land avoiding water from boreholes because of its high saline content. On the other hand there were complaints of aquifers being far removed from the surface, thus making the digging of wells laborious and in most cases unproductive.

4.5 The Non-endemic Area

Dr. Bugri explained that the Walewale and Nalerigu areas of the Northern Region managed to escape the guinea worm epidemic because of their culture of avoiding direct contact with surface sources of water supply, by digging shallow outlying wells close to their surface sources of water supply. The seepage of water from the main water body to the outlying shallow well automatically filtered their water of biologically infectious agents. By obtaining their water in this way the people of Walewale and Nalerigu and their surrounding areas escaped getting infected with the disease through the cultural practice of isolating the biologically infectious agent of the disease by unconsciously filtering their surface sources of water supply using their bio-physical environment.

Hunter (1966b) observed in his studies on onchocerciasis in the Upper Region of Ghana that "the pathway to diseases are geographical". That was to say the location of people in a particular geographical area and their way of life could predispose them to some form of disease. Their way of life could be influenced by their climatic conditions and physical

environmental characteristics. In a similar way Hunter's argument could be said to hold true by also arguing that the pathway to avoiding disease is also geographical through elimination of environmental causes.

It was therefore observed during the research that the pathway to guinea worm infections in the region was geographical as Hunter pointed out, in the sense that the way of life of some ethnic groups, their climatic conditions and the physical environment of the former guinea worm endemic areas made them vulnerable to GWD. Conversely, it was also observed that the pathway that led to some ethnic groups in the region avoiding the disease was also geographical; in the sense that the ethnic groups which occupied particular geographical areas adopted the practice of unconsciously filtering their surface water and not coming into direct contact with their surface sources of water supply. To further advance Hunter's argument the research added to it by suggesting that the pathway to the condition of health of a people can be said to be influenced by cultural and geographical conditions.

It was foumd that physical and cultural circumstances, and environmental conditions influenced the spread of the disease among the Dagomba, Gonja, Nanumba, and Konkomba areas; and it was purely cultural circumstances and bio-physical environmental conditions that influenced the escape of the Walewale and Nalerigu areas from the epidemic.

4.6 Endemic foci of guinea worm infections in Northern Region

The first proposition of the research was "guinea worm infections were restricted to hyper endemic foci of the disease in the Northern Region of Ghana". There are two major forms of endemicity. They are hyper endemicity and hypo endemicity. In between these two forms of endemicity is the intermediate level of endemicity, which is meso endemicity. Meso endemicity indicates that prevalence of a disease is neither too high nor too low.

When a disease prevails at hyper endemic levels there is an outbreak of an epidemic of that particular disease. Meso endemic levels indicates that whereas the disease does not prevail at the level of an epidemic, its presence still has a material effect on the health and socio-economic wellbeing of the people among whom it is found. It also has the potential of progressing towards hyper endemic levels. A disease is said to be at hypo endemic levels when prevalence of the disease is so low as to be considered as isolated cases which can be contained or prevented from spreading beyond the affected individuals. Hypo endemicity most likely has no material effect on the health and socio-economic welfare of the population among whom the disease is found.

The programme identified eleven districts to be endemic with the disease. However, upon carefully examining existing records of reported cases of guinea worm infection in the region, it was found that ten administrative districts harboured the disease at hyper endemic levels. They were the Nanumba North district, Central Gonja district, East Gonja district, West Gonja district, Gushiegu district, Savelugu-Nanton district, Tolon-Kumbungu district, Yendi district, and the Tamale Metropolitan Area. By this description the Konkomba area had one district that was hyper endemic to the disease; the Gonja area had three districts that were hyper endemic to it, while the Dagomba area had six districts that were hyper endemic to the disease.

Next to follow were the districts that harboured the disease at meso endemic levels. They were the Zabzugu-Tatale district and the Nanumba South district in the Konkomba-Nanumba area of the Northern Region of Ghana.

Last on the rung of guinea worm endemic districts were the hypo endemic districts of Saboba, Chereponi, Kpandai, Bole, and West Mamprusi. By this description the Konkomba area harboured three districts that were endemic to the disease, while the Gonja and Nanumba areas harboured one hypo endemic district each. All put together, this brought the number of districts that experienced GWD in one form or the other from eleven endemic districts to seventeen hyper, meso, and hypo endemic districts. The breakdown is as follows: ten hyper endemic districts, two meso endemic districts, and five hypo endemic districts.

There were the notable cases of the Tamale Metropolitan Area harbouring the disease at the hyper endemic level and the West Mamprusi district recording cases of guinea worm infections at the hypo endemic level. The Tamale Metropolitan Area is known traditionally not to be an endemic focus of the disease, given the fact that it has benefitted a lot from potable sources of water supply. A likely explanation for the occurrence of recorded cases of guinea worm infections in this area could be that the infections are located in the peripheral areas of the Tamale Metropolitan Area, thus predisposing the people in this area to engage in cross border district activities with the traditional guinea worm endemic districts of Yendi, Savelugu-Nanton, Kumbungu, Central Gonja, and East Gonja.

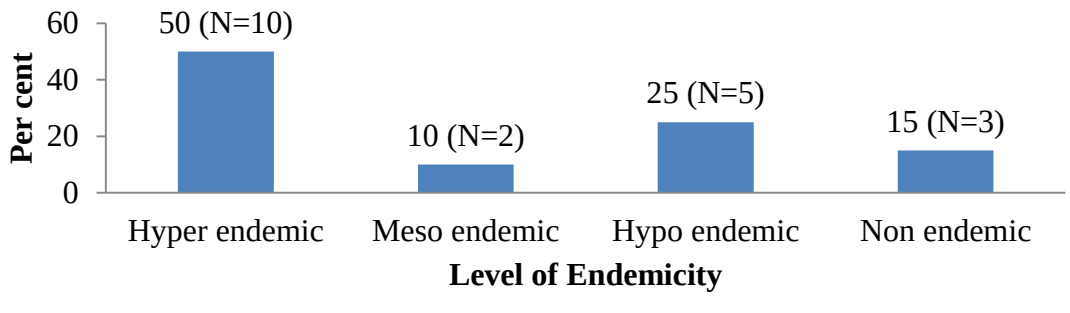
With respect to the West Mamprusi district which has been established to be an area where GWD is unknown, the occurrence of isolated cases of the disease between 2007 and 2008 suggest that these cases were imported into the district from other parts of the Northern Region where the disease is endemic; notably, the neighbouring districts of Gushiegu, Karaga, Savelugu-Nanton and Tolon-Kumbungu which share a common border with the district.

The districts that are on record not to have recorded any case of guinea worm infections in the Northern Region of Ghana are the Sawla-Tuna-Kalba district, the East Mamprusi district and the Bunkpurugu-Yunyo district. These districts are located in the Vagla and Mamprusi areas of the Northern Region of Ghana.

It was therefore found from the analysis that the proposition that GWD was found only in hyper endemic foci of the Northern Region did not hold true. The disease was reported to have occurred in other parts of the region at meso endemic and hypo endemic levels. The disease was found to be hyper endemic in 50% of the districts in the region, meso endemic in 10% of the districts in the region, and hypo endemic in 25% of the districts of the region. The remaining 15% of the districts in the region were found not to be on the official record of guinea worm endemic districts in the region.

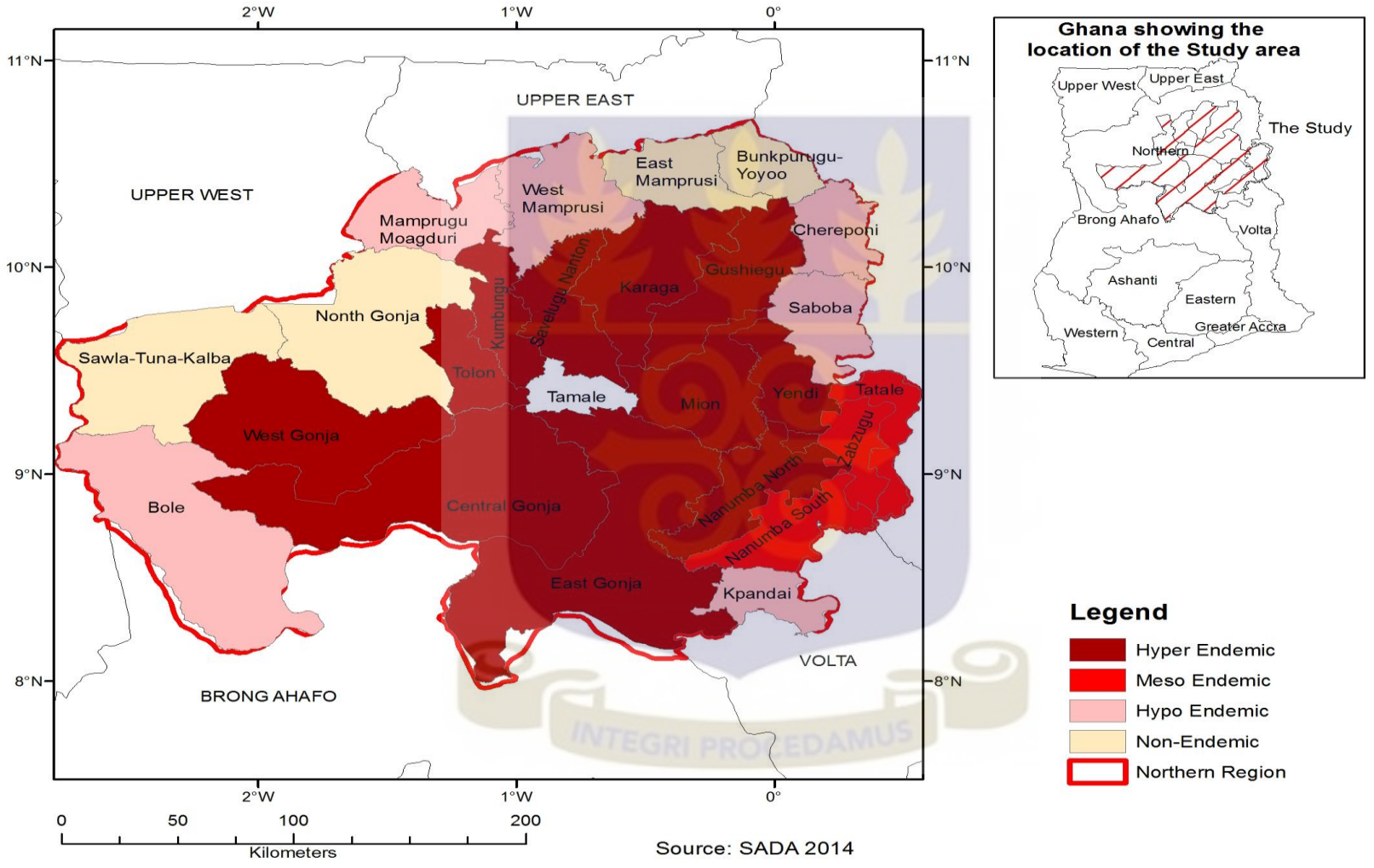
Because the disease was found in 85% of the districts of the Northern Regio, at various levels of endemicity the first proposition was replaced with the following proposition: the disease prevailed in the region at different levels of endemicity. Figures 4.6, 4.7 and 4.8 are a geographic representation of the occurrence of the disease in the region by district and ethnic areas according to their various levels of endemicity.

Figure 4.6: Endemicity level of the GWD in the Northern Region



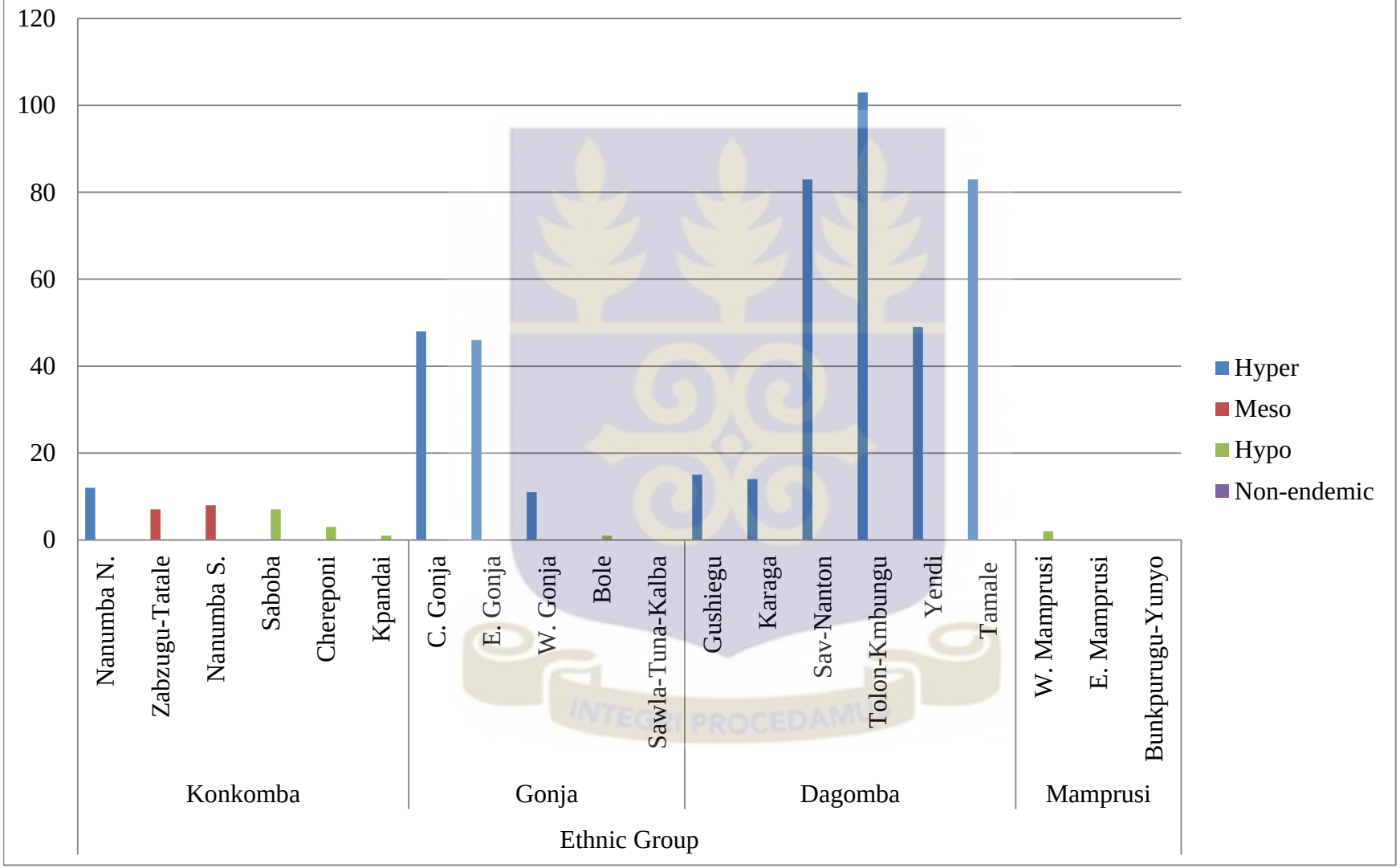
Source: GWEP/GHS. Januarv. 2012

Figure 4.7: Guinea worm endemicity by district in Northern Region: 1989-2011



Source: Ghana Health Service/GWEP, January 2012

Figure 4.8: Guinea worm endemicity by district and predominant ethnic group: 1989-2011



Source: Ghana Health Service/GWEP January 2012

The epidemiological factors which influenced the levels of guinea worm endemicity in the Northern Region formed the basis for examining the socio-economic impact of the guinea worm epidemic in the study area which led to the implementation of the GWEP.

CHAPTER FIVE

THE DETERMINANTS OF GUINEA WORM ENDEMICITY AND ITS SOCIO-ECONOMIC IMPACTS IN THE REGION

5.1 Introduction

The social infrastructure that influenced endemicity levels of GWD prior to the implementation of the GWEP was examined along the following themes: examining the types of drinking water sources which influenced the spread of the disease guinea worm endemic districts of the Northern Region; and, offering some possible explanations for the distribution of the water supply situation that influenced the spread of the disease in the former guinea worm endemic areas of the region.

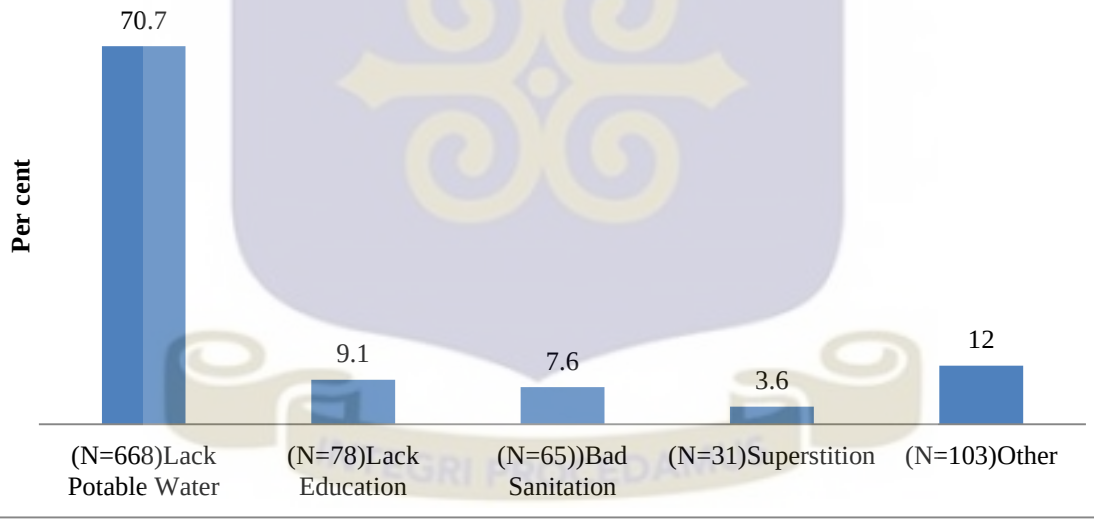
The analysis of the distribution of sources of water supply facilities for the entire Northern Region and the former guinea worm endemic areas of the region was examined with respect to the provision of pipe borne water, bore holes, wells, rain water, and open water bodies (dams, dugouts, rivers, springs, ponds, lakes, and canals). The time frames that were used to analyze the provision of water to the region and the study area was 1970 and 1984; these periods being the years when census data on water supply facilities was captured before the GWEP was started. The availability of potable water during these periods was set against the number of reported cases which the national search for cases of guinea worm in 1989 established for the region, to amplify the severity of the epidemic with respect to the provision of safe and unsafe sources of drinking water.

The analysis of the water systems that influenced the prevalence of the disease in the Northern Region was immediately followed with the socio-economic and ecological effects the guinea worm epidemic had on the people of the region. The socio-economic and ecological effects were discussed with respect to economic productivity, parenting roles, the pain and immobilizing effect of the disease, business obstructions, improper use of surface sources of water supply, poor school attendance, and the death threatening situations that were attributed to the disease.

5.2 Knowledge of cause of GWD

Respondents were interviewed to find out if they knew what caused GWD before the GWEP was implemented. The details of the findings are shown in Figure 5.1.

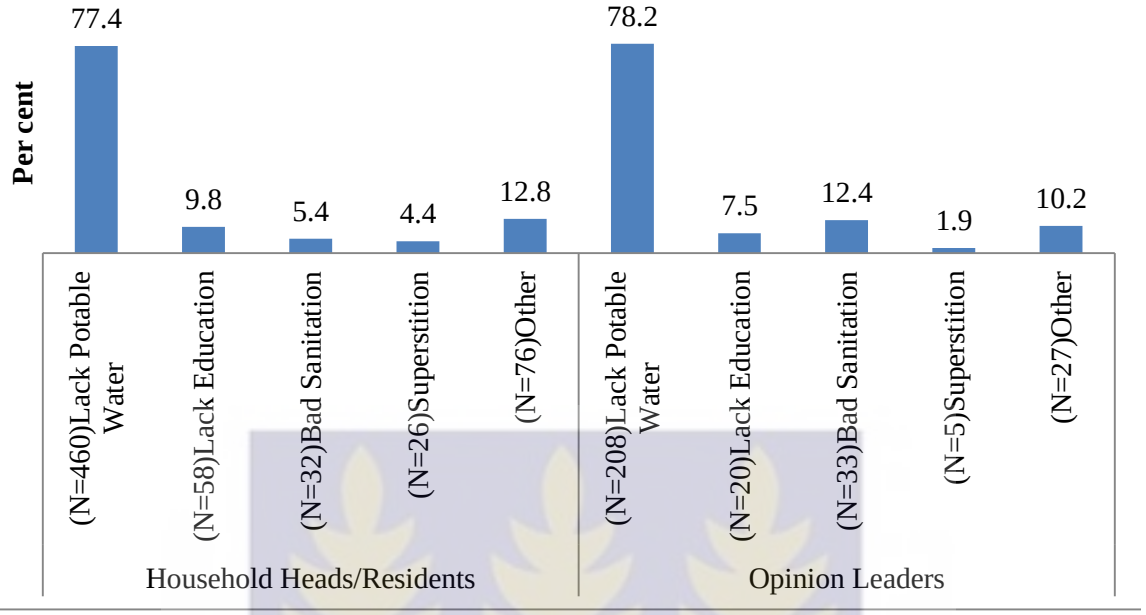
Figure 5.1: Knowledge of cause of GWD



Source: Field Data, September 2012 – January 2013

Figure 5.1 shows that majority (70.7%) of respondents attributed the cause of the disease to poor access to potable water. The rest (3.3%) attributed the cause of the disease to ignorance and superstitious beliefs.

Figure 5.2: Knowledge of cause of GWD by respondent category

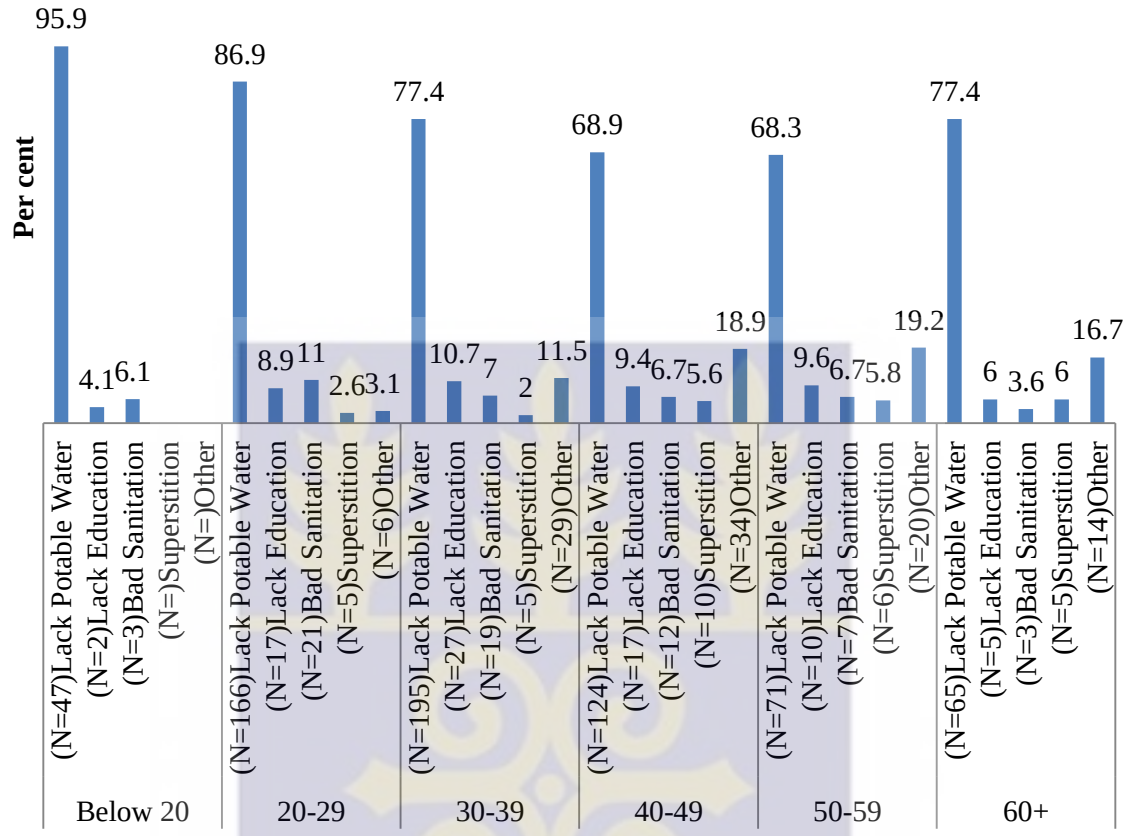


Source: Field Data, September 2012 – January 2013

With regard to respondents perception of the cause of the disease by respondent category Figure 5.2 above revealed that 77.4 % of household heads/residents and 78.2% of opinion leaders attributed the cause of GWD to poor access to potable water. Some 9.8% of household heads and 7.5% of opinion leaders thought the disease was caused by lack of knowledge about the disease.

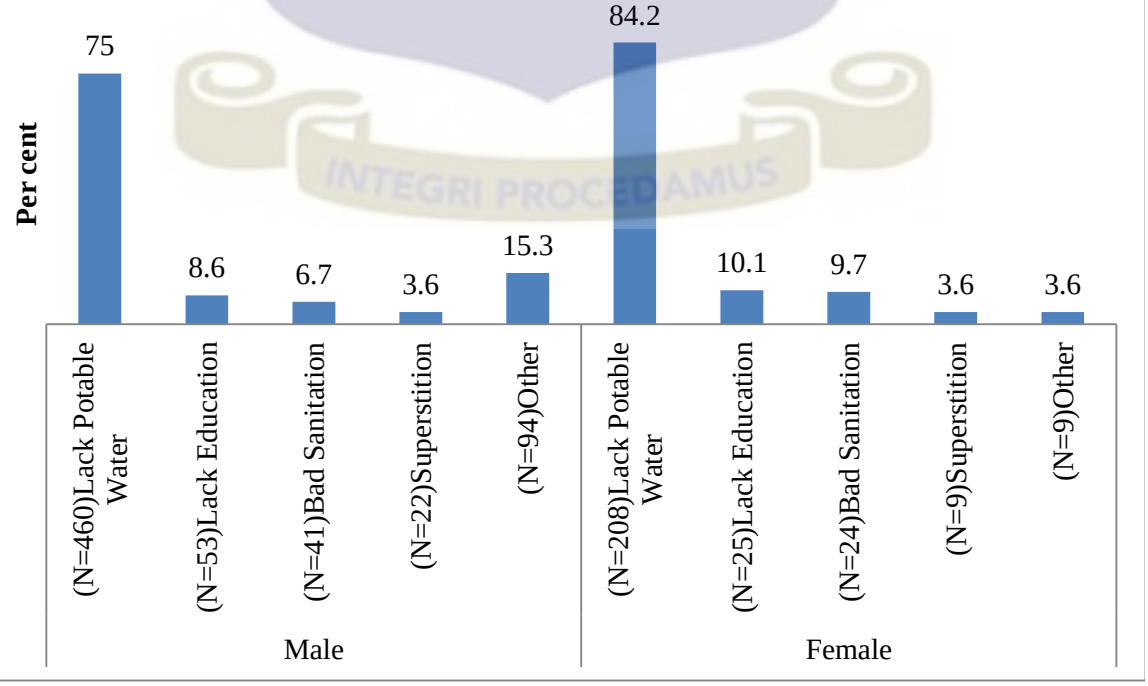
Respondent's knowledge of the cause of the disease by age are shown in Figure 5.3. From Figure 5.3 it was realized that respondents from all age groups with an average of 79% for each age group indicated poor access to potable water as being responsible for the prevalence of the disease. The remaining responses of lack of knowledge about the disease, bad sanitation practices, and superstitious beliefs in all age groups had an average response of 6.5% among respondents for each age group. This meant that respondents in all age groups had sufficient knowledge of the cause of the disease.

Figure 5.3: Knowledge of cause of GWD by age



Source: Field Data, September 2012 – January 2013

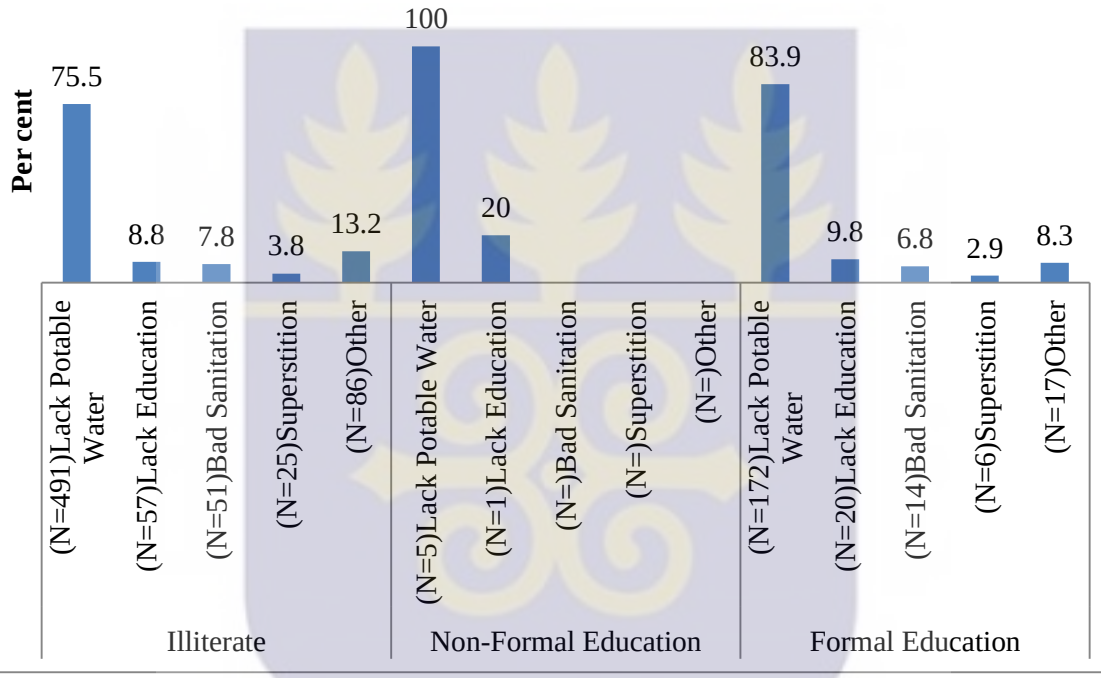
Figure 5.4: Knowledge of cause of GWD by gender



Source: Field Data, September 2012 – January 2013

Figure 5.4 showed respondents' knowledge of the cause of the disease by sex indicated 84.2% females and 75% males attributed the cause of the disease poor access to potable water. Lastly, respondents who indicated the disease was caused by lack of knowledge about the disease, bad sanitation and superstitious beliefs had an average of 7% for both sexes subscribing to this. This meant that respondents knowledge of the disease by sex was good.

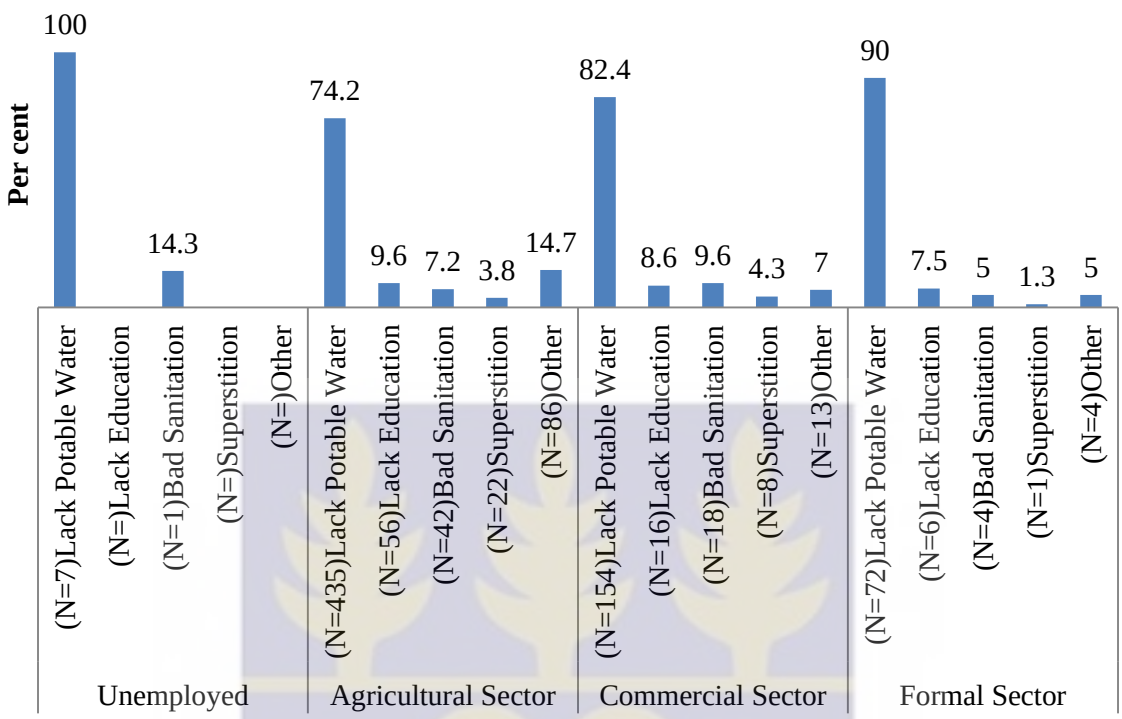
Figure 5.5: Knowledge of cause of GWD by education



Source: Field Data, September 2012 – January 2013

Figure 5.5 examined respondents' knowledge of the cause of GWD by educational attainment. It was found that all respondents with non-formal education (100%), those with formal education (83.9%), and illiterate respondents (75.5%) attributed the cause of the disease poor access to good drinking water. The remaining responses like in previous situations were in the minority. However, the two responses put together indicated that respondents knowledge of the cause of the disease by education was also good.

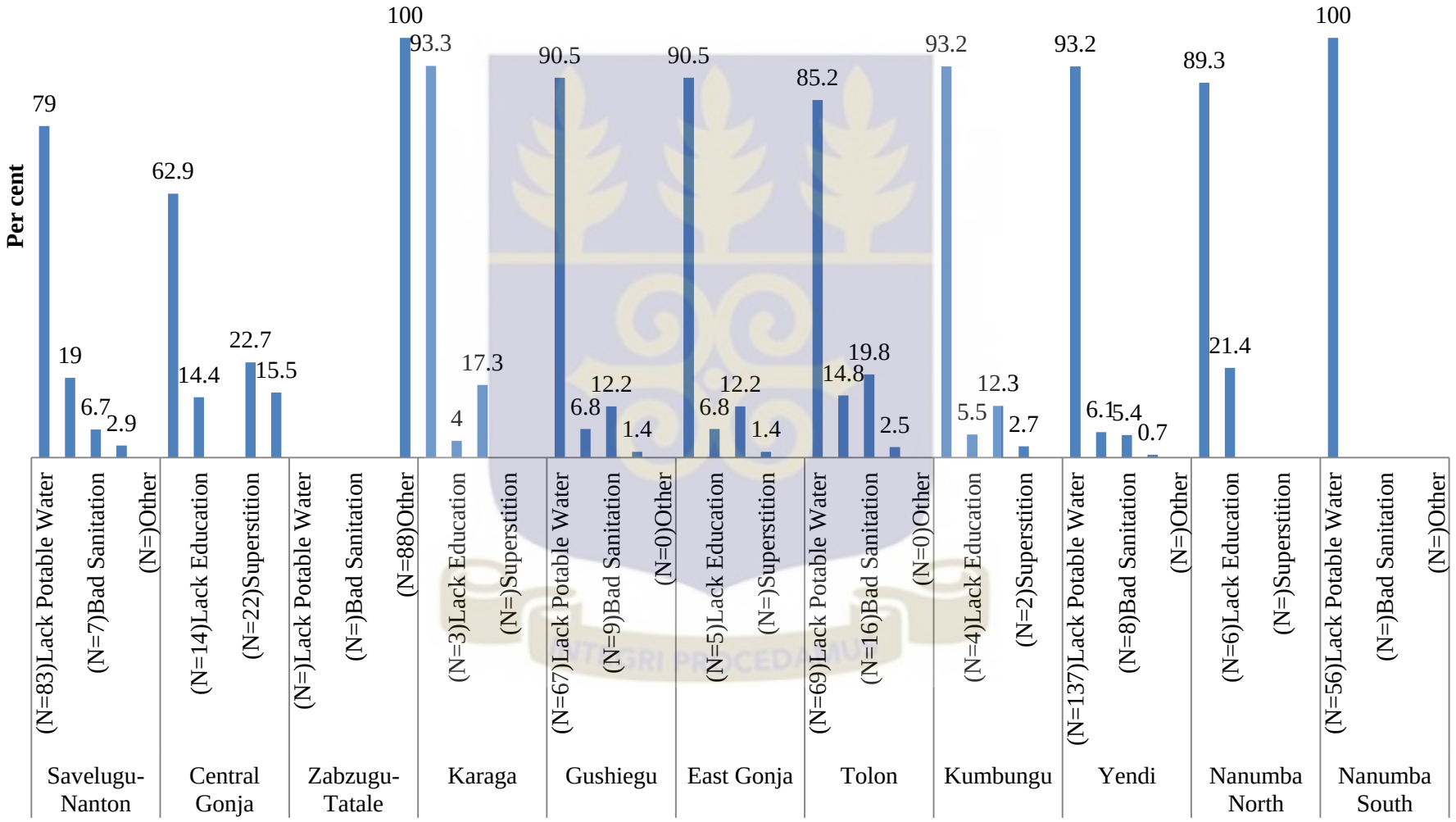
Figure 5.6: Knowledge of cause of GWD by occupation



Source: Field Data, September 2012 – January 2013

With regard to the cause of the disease by occupation, Figure 5.6 revealed that all of the unemployed (100%), majority of respondents in formal sector (90%), the commercial sector (82.4%), and the agric sector (74.2%) had knowledge of the cause of the disease as attributed it to poor access to potable water. The rest of the responses were almost evenly distributed between respondents among the agric, commercial, formal, and unemployed with each having an average of 6.5% respondents each. Here again, knowledge of the cause of the disease by occupation, including the unemployed was found tobe good among all categories.

Figure 5.7: Knowledge of cause of GWD by district



Source: Field Data, September 2012 – January 2013

On the question of what respondents thought was responsible for the prevalence of the disease by district, Figure 5.7 revealed that respondents from all the guinea worm endemic districts with an average of 87.7% of respondent in each district, with the exception of the Zabzugu-Tatale, indicated that poor access to potable water was responsible for the spread of the disease. ZabzuguTatale did not have respondent reporting on poor access to potable water because the areas within which questionnaire data was gathered was within the catchment area of the River Oti where the inhabitants of the area fetch their drinking water.

Table 5.1: Chi-square test on knowledge of cause of GWD

Variable	Value	df	Asymp. Sig
Respondent Category	574.832	478	.002
Age	2540.871	2390	.016
Gender	515.095	478	.117
Education	1947.077	1912	.283
Occupation	1691.715	1431	.000
District	6799.063	4780	.000

Source: Field Data, September 2012 – January 2013

From table 5.1 above, knowledge of the cause of GWD with respect to respondent category, age, gender, education, occupation, and district were subjected to Pearson's Chi square test to determine which of them are statistically related. At a significance level of 0.05 it was found that the p-values for respondent category, age, occupation, and district are significantly related to knowledge of the cause of the disease as these variables are less than 0.05. However, knowledge of cause of the disease at the same significance level was unrelated to gender and education as these variables had p-values higher than 0.05.

After examining what respondents thought was responsible for the cause of the disease the research examined the sources of water supply in the region which exposed the people of the region to the infectious agent of the disease.

5.3 Types of drinking water which influenced the spread of GWD

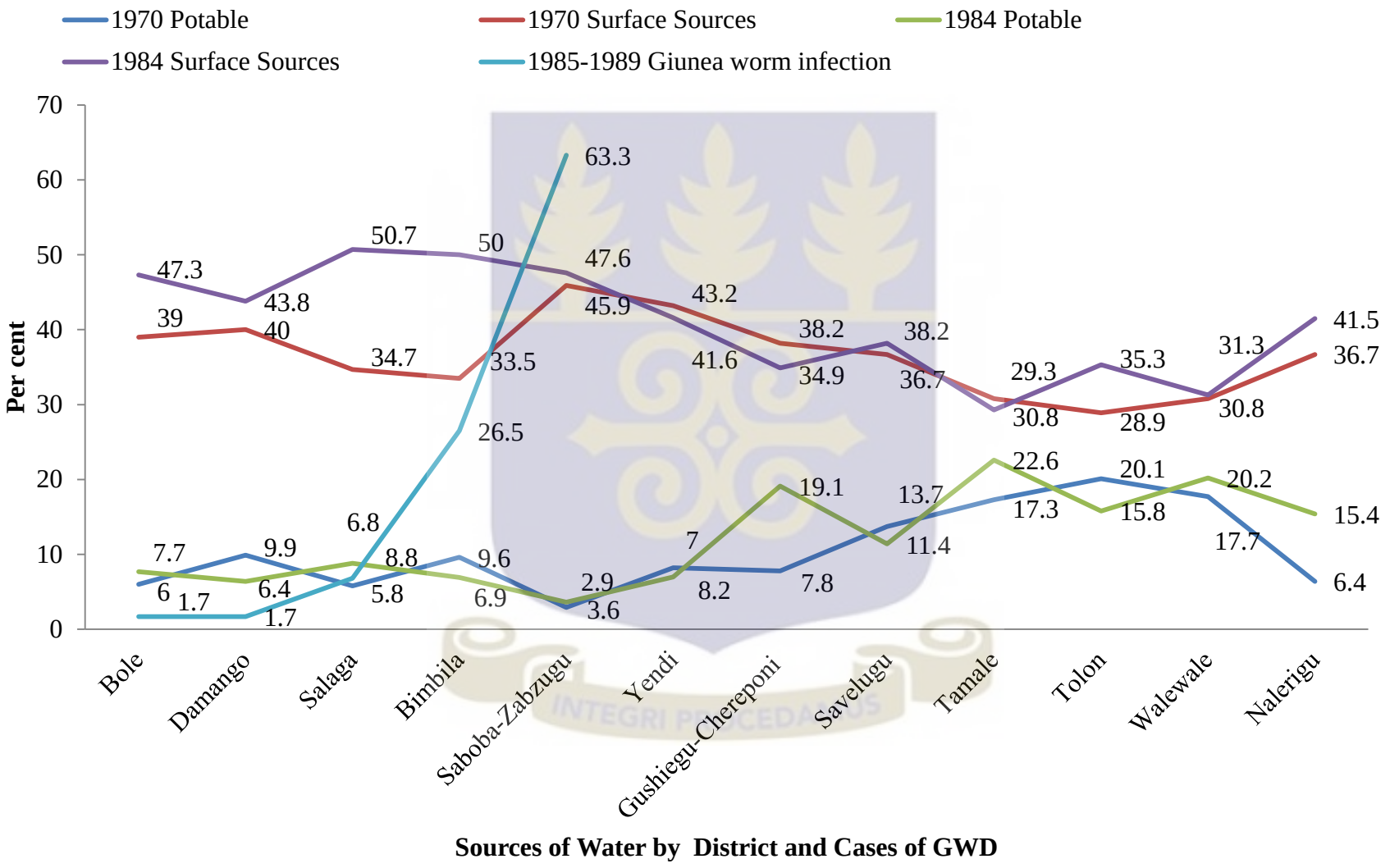
Apart from the cultural practices of the people of the region which contributed to the spread of the disease, the provision of water facilities also contributed to the spread of the disease. The disease existed in Ghana before the 1960 (Waddy, 1956); but it was officially reported in Ghana's health records in the 1960s (Bugri, 1981, 1993; Diamenu and Nyaku, 1998). There was therefore the need to examine the types of water supply facilities that existed in the region before the programme was started; that is between the 1960s and the late 1980s. The data that was available for the examination was from the 1970 and 1984 population censuses of Ghana.

The major source of water supply in the region in the 1970s was pipe borne water (38.8%); this was followed by rain water (31.3%); then boreholes (28.4%); with wells and open water bodies following each other closely with 15% and 14.9% respectively. From the early 1980s to 1989 (the year when the GWEPwas started) the major sources of water supply in the Northern Region were as follows: rain water (83.3%); piped borne water (32.4%); bore hole (28%); open water bodies (27%); and wells (17.9%).

These sources of drinking water were further classified into two major sources: potable and surface sources of drinking water. During the period under review it was found that the Northern Region relied more on surface sources (77.4%) of drinking water than potable sources (22.5%).

The details of these findings are presented in Figure 5.8. The endemic area of Saboba-Zabzugu was found to have the highest reliance of 46% on surface sources of drinking water in the 1970s. In the 1980s the guinea worm endemic areas of Salaga and

Figure 5.8: Types of drinking water which influenced endemicity levels of GWD in Northern Region between 1970 and 1989



Source: Ghana Statistical Service, 1970 and 1984 Population censuses of Ghana

Bimbilla were found to have the highest reliance of 51% and 50% respectively on surface sources of drinking water. Areas with lowest reliance on surface sources of drinking water during the period under review was Tolon with a reliance value of 28.9% in the 1970s and Tamale with a reliance level of 29.3% in the 1980s.

With regard to potable water for the period under review it was found that areas that relied most on potable water in the 1970s were Walewale and Tamale districts with relatively close values of 17.7% and 17.3% respectively. In the 1980s Tamale district was found to have relied more on potable sources (22.6%). These values when compared with surface sources of drinking water for the period under review were found to be considerably lower than the lowest values for surface sources of drinking water.

In furtherance of this discussion it was observed that some 12.7% of respondents from the Nanumba and Dagomba areas mentioned their dependence on open water bodies with its consequent environmental effects on their lives. Respondents in the Gonja areas mentioned taking their baths and washing their clothes in surface sources of drinking water. The Nanumba indicated that they did not have access to good water and because of that they relied very much on streams and rivers for their drinking water. Some respondents intimated that because they did not have knowledge on how to avoid the disease they used water from surface sources without rendering the cyclops of the guinea worm ineffective.

It was also observed in Figure 5.8 that the number of reported cases of guinea worm infections in the Northern Region between 1985 and 1989 (the year when the GWEP received global support) experienced exponential increases from 1.7% in 1985 to 26.5% in 1987to 63.3% in 1989.

GWD is transmitted by coming into contact with unsafe sources of drinking water (surface sources), and ingesting water contaminated with guinea worm larvae. The high reliance on surface sources of drinking water coupled with the exponential increase in the number of reported cases of guinea worm infections during the period under review, made it possible to infer that poor access to potable water and a high reliance on unsafe sources of drinking water played an important role in exposing residents of the Northern Region to the disease. This situation was readily understood for poor and rural communities in the Northern Region considering the fact that most residents in some urban communities in Ghana found it difficult to access direct supply of water to their homes because the cost of procuring such services was in their estimation quite prohibitive (Songsore and Stephens, 2008). Simillarly cost of providing potable water in the region from a geological and economic perspective was quite expensive from and institutional point of view.

There factors other than the availability of safe sources of water supply that contributed to the spread of the disease in the region. An interview granted by Dr. Sam Bugri during the field work (September 2012 –January 2013) lent credence to the idea that cultural beliefs and practices, and climatic conditions were some of the driving forces that accounted, for cases of guinea worm infections and, for the absence of cases of guinea worm infections in the Northern Region of Ghana. Even though the Dagomba districts of Savelugu, Gushiegu, and Tolon, had the highest reliance on pipe borne water, boreholes and wells, yet they recorded cases of guinea worm infection during the 1970s and 1980s. The explanation for the recorded cases of guinea worm infections despite the presence of potable sources of water supply in the Dagomba areas such as those mentioned above was due to the cultural belief of the "knee deep" level of fetching water, which was held in the Dagomba areas. The "knee deep" level of fetching water was the belief and practice of wading to "knee deep" level in ponds and

dams to fetch "clean" water. This was probably due to the fact that water at the edge of ponds and dams are considered unclean due to disturbance by humans and livestock stepping in to drink water. But water far removed from the edge of dams and ponds are considered calm with dirt particles lying at the bottom of these water bodies.

The parts of Gonja Traditional Area that were affected by the disease were observed to have benefitted quite generously from sources of potable water supply: Salaga had 9.6% of wells as compared to 15% for Tolon; 17.6% of boreholes as compared to 28.4% for Gushiegu, a guinea worm hypo-endemic community; 10.7% of wells as compared to Nalerigu's 17.9%; 15% of boreholes as compared to Gushiegu's 28%; in the 1970s and 1980s respectively. Dr. Sam Bugri indicated that the Gonja areas that were affected by the disease preferred ponds and step wells to their available boreholes because of the hydro-geological factor of some of their available sources underground water being salty. Further south of the region, for instance Yendi, Saboba-Zabzugu, and the Bimbilla district, Dr. Sam Bugri noted that these areas enjoyed climatic conditions in which their rivers, ponds and spring have perennial life spans. The people in these areas who did not have access to potable sources of drinking water (boreholes and deep wells) relied on these sources of water supply without taking the necessary precautions to avoid stepping into the water. This practice exposed guinea worm infectives to such sources of water supply, resulting in the release of microfilaria in these waters.

The Nalerigu and Walewale districts were found to rely less on potable sources of water supply: for instance, Walewale had 7.9% of the Northern Region's wells, 1.5% of the Northern Region's piped borne water, with Walewale and Nalerigu each having 1.4% of the Northern Region's boreholes; and Walewale again having 6.9% and 1% of the regions

boreholes, in the 1970s and 1980s respectively; yet these districts did not fall victim to the disease. Dr. Bugri noted that despite the high reliance of these districts on surface sources of drinking water, these areas had the culture of avoiding stepping directly into step wells and other open water bodies by digging shallow outlying wells near open water bodies and fetching their water from these shallow wells instead of stepping directly into the main surface source of water supply.

Apart from the cultural practice of fetching water from outlying shallow wells that were dug close to the main water body, the Mamprusi and Bimoba areas have a hydro-geological character of high water tables and a copious assemblage of permeable rocks. Because of the generally high water table throughout the year the Mamprusi area relied mostly on wells for their water supply. For instance in the 1980s the Mamprusi area registered the highest reliance on wells, with some 17% of the region's wells located in the Nalerigu district. The Mamprusi relied mostly on deep wells in which human contact with underground water was eliminated. Even with the outlying shallow wells human contact with filtered water from the main water body was avoided. The permeable rocks of the Mamprusi and Bimoba areas expelled their excess waters, especially during the rainy season which flowed along outlying rocky country thus exposing the water to aeration. Since these waters are not stagnant the survival of the cyclops of the guinea worm is rendered practically impossible. Therefore, people who came in contact with these flowing waters, running from highly saturated permeable rocks, virtually run no risk of polluting the water with guinea worm larvae or ingesting the guinea worm cyclops through drinking.

From the above discussion on the epidemiology of the disease it can be concluded that an overwhelming dependence on unsafe sources of drinking water and a set of cultural practices,

environmental conditions, climatic influences, and real or imagined perceptions on the quality of water influenced the prevalence and spread of the epidemic in some parts of the region and, the absence of the disease in other parts of the region. These epidemiological factors found expression in the hybrid conceptual framework of disease diffusion and disease ecology of Figure 2.2, where the agent-host factor relationship (biological, physical, and social factors) ensured the local survival of infective larvae at the community level and, subsequently diffusing externally over time to cover wider geographic space at the regional level. The social agent-host factor relationship that influenced the prevalence of the disease in the region was the 'knee deep' culture of fetching 'good' water from ponds. Similarly, the social agent-host factor relationship that prevented the disease from occurring in other parts of the region was the cultural practice of digging shallow outlying wells close to dams, ponds, and dug-outs.

Another social agent-host factor relationship that influenced the local survival and subsequent spread of infective larvae of the disease in the region was the real or imagined perception (Johnston et al, 2000) of the taste of potable underground water among some ethnic groups in the region. This acted as a push factor to make the people of these areas to turn to alternative sources of drinking water – ponds, dugouts, and stepwell – (Plate 2), where without their knowledge, infective larvae of the worm survived locally.

The physical agent-host factor relationship that influenced the local survival and subsequent spread of infective larvae of the worm to cover wider geographic space in the Northern Region was the prevailing environmental and climatic conditions that sustained the thriving of stagnant water bodies in the dry season to which people who have no alternative to potable water supply have to turn to. The idea of the disease diffusing from the local level to cover

wider geographic space stems from the fact that there have been reported cases of guinea worm infections being imported into Ghana from neighbouring Togo into the Volta Region, the Northern Region (Diamenu and Nyarko,1988).

Plate 2: Reliance on surface sources of drinking water

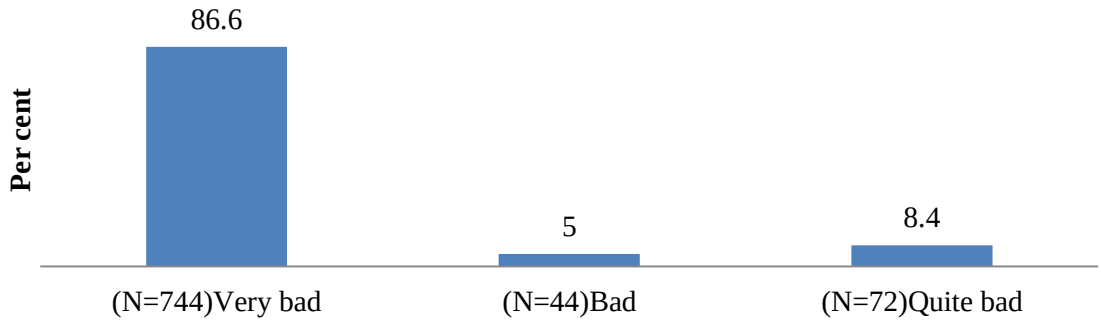
Source: Courtesy of Guinea Worm Photo Gallery Ghana

To sum up, the conceptual framework was found to have the dual function of explaining the prevalence and subsequent spread of disease to cover wider geographic space and, preventing the survival of an infectious agent of disease at the local level.

5.4 The condition of health of people during the guinea worm epidemic

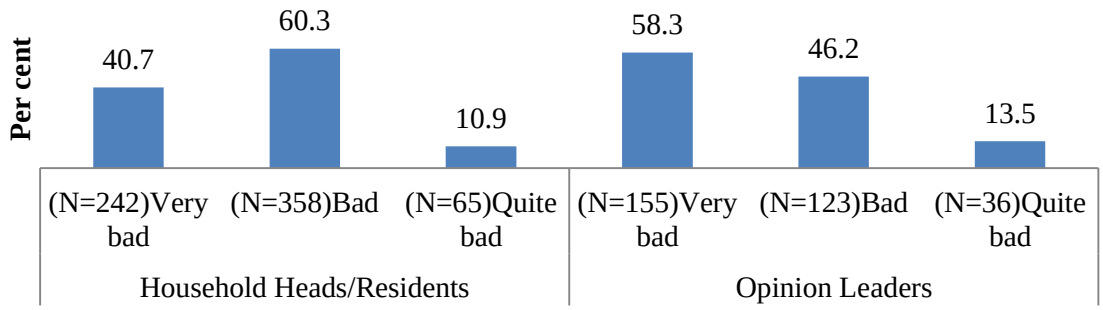
Figure 5.9 presented respondents views on the health situation during the guinea worm epidemic. It was realized that 87% of respondents said the health situation was very bad, with 13.4% indicating that the health situation was either bad or quite bad.

Figure 5.9: Condition of health during guinea worm epidemic



Source: Field Data, September 2012 – January 2013

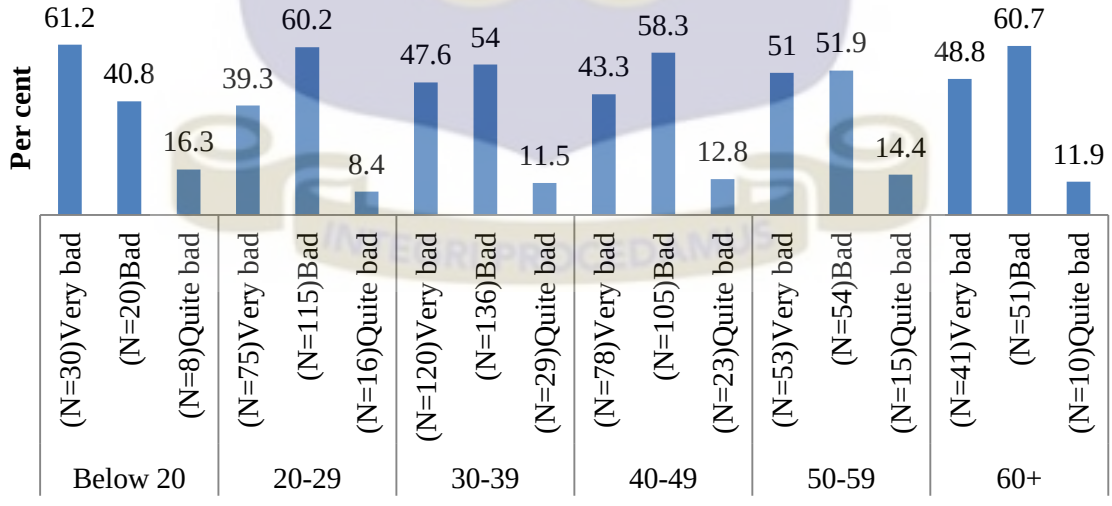
Figure 5.10: Condition of health during guinea worm epidemic by respondent category



Source: Field Data, September 2012 – January 2013

On the health situation of the epidemic by respondent category Figure 5.10 showed that more opinion leaders (58.3%) than household heads/residents (40.7%) indicated that the health situation during the epidemic was very bad. Also more household heads (60.3%) than opinion leaders indicated the health situation was bad (46.2%). Overall, the health situation was either very bad, bad, or quite bad with an average of 38.3% each of respondents for each category subscribing to this view.

Figure 5.11: Condition of health during guinea worm epidemic by age

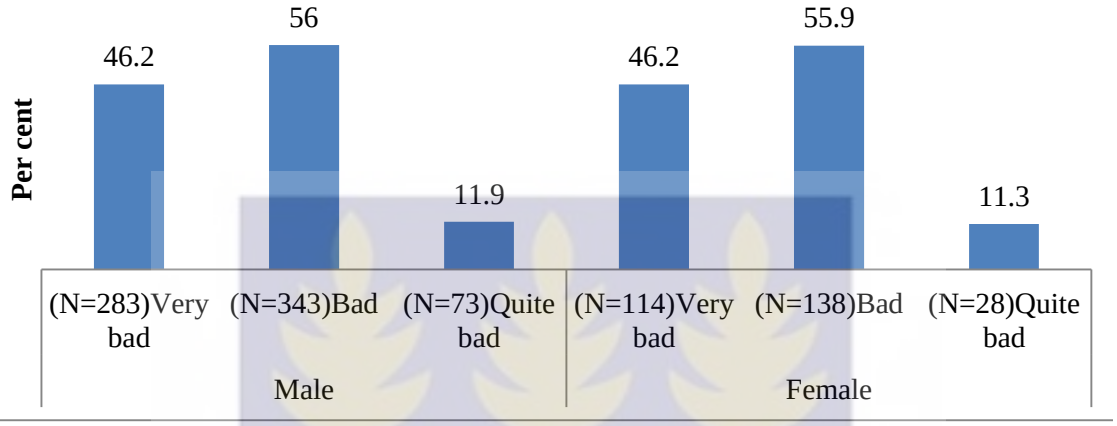


Source: Field Data, September 2012 – January 2013

On the health situation of the epidemic by age Figure 5.11 revealed that respondents in the various age groups were of the view that the health situation was either very bad or bad.

Respondents below 20 years indicated the health situation very bad (61.2%) and those between 20 years and above 60 years, with each having an average of 56.8% indicating that the health situation during the guinea worm epidemic was bad.

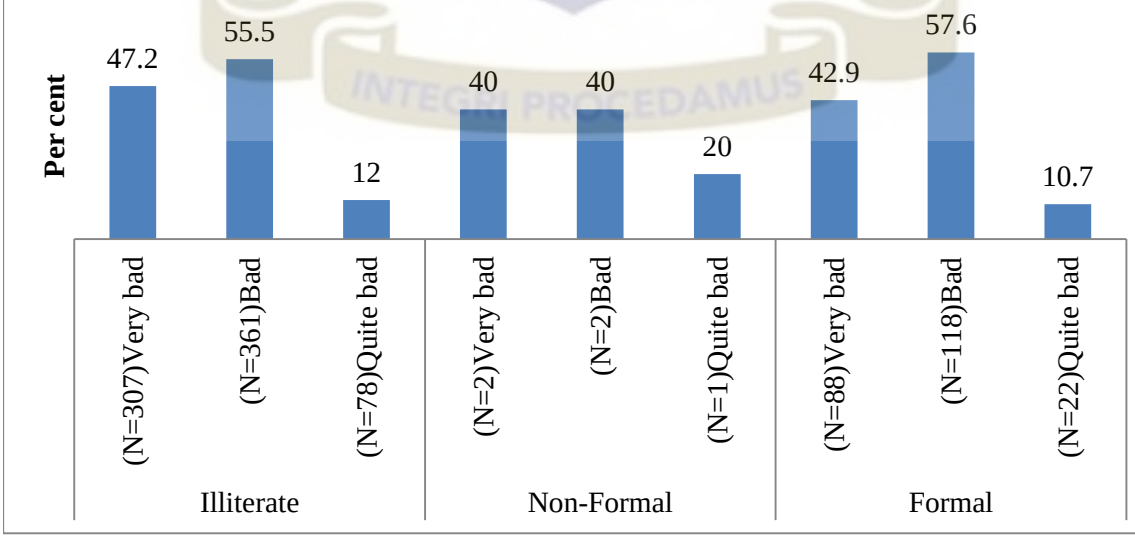
Figure 5.12: Condition of health during guinea worm epidemic by gender



Source: Field Data, September 2012 – January 2013

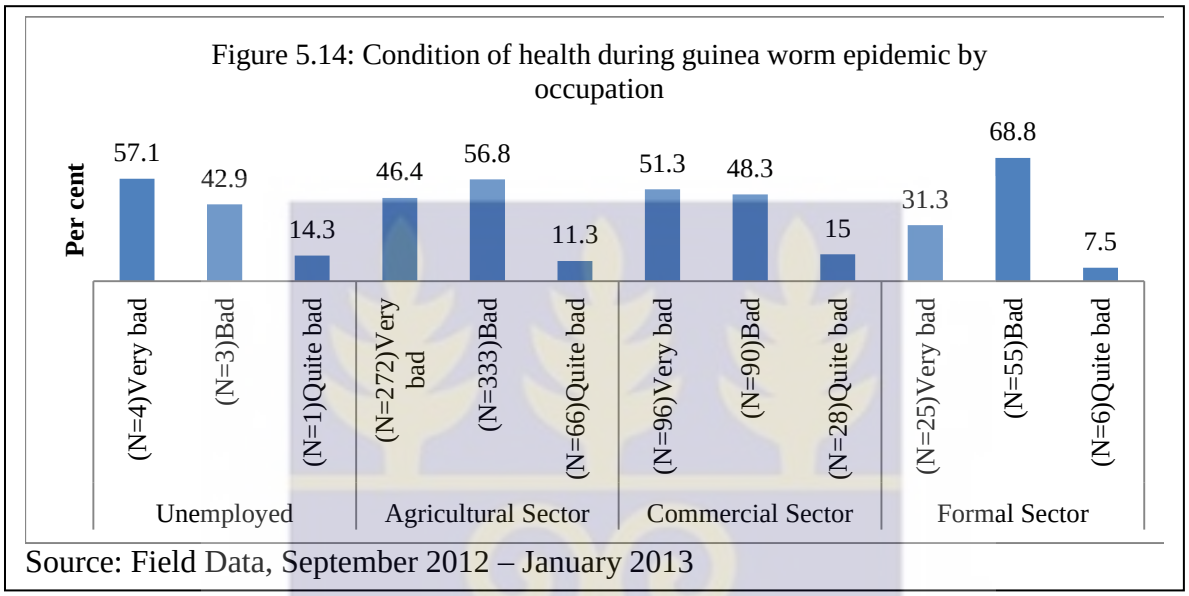
When the issue of health was examined by sex it was found, in Figure 5.12, that an almost equal proportion of male (51.1%) and female (51.1%) respondents said the health situation was very bad or quite bad, with an average of 37.9% for each response for both sexes indicating that the health situation was either very bad, bad, or quite bad.

Figure 5.13: Condition of health during guinea worm epidemic by education



Source: Field Data, September 2012 – January 2013

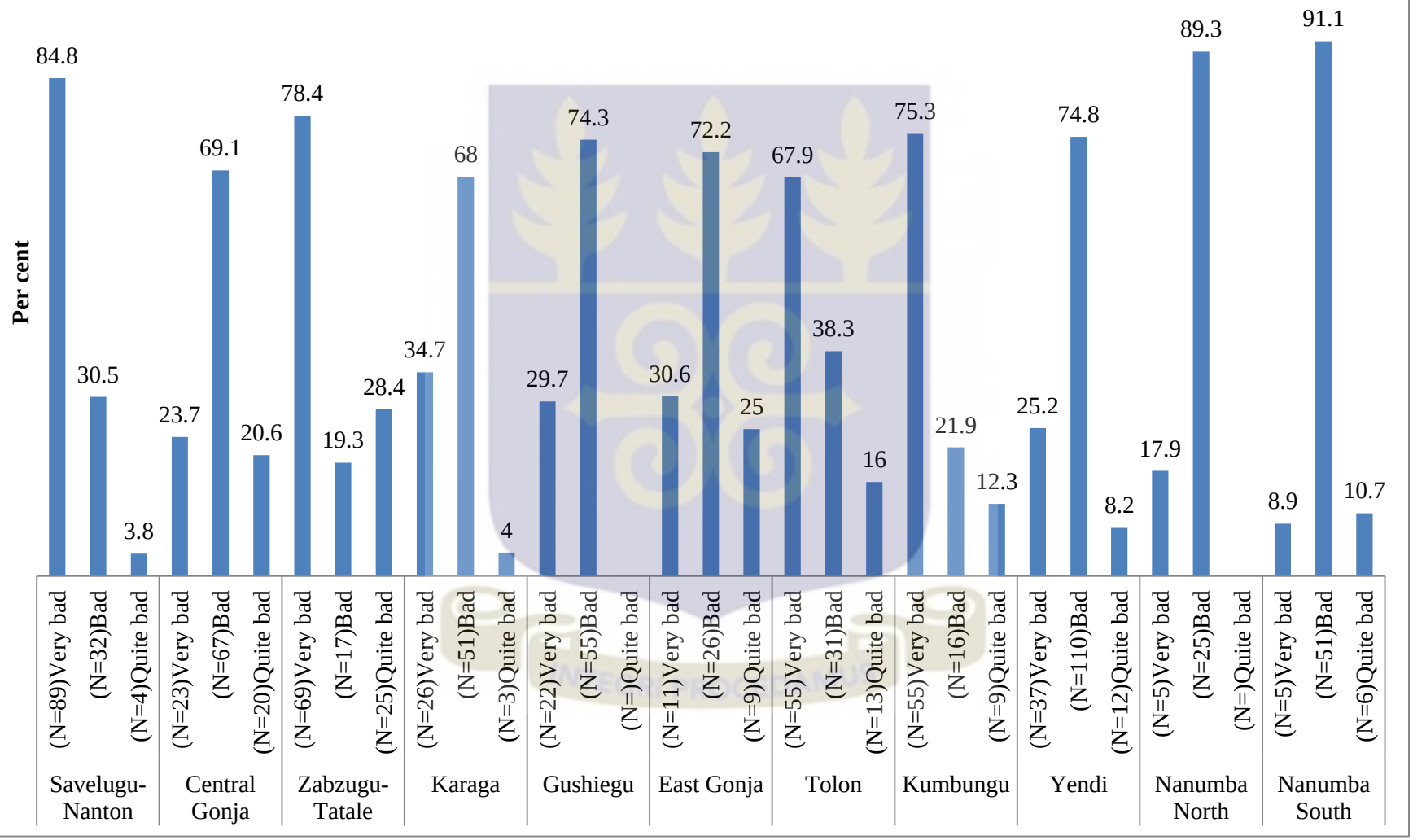
On the issue of health during the epidemic by education Figure 5.13 revealed that illiterate respondents and respondents with some form of education indicated the health situation was overwhelmingly bad. It was found that an average of 47.2% for each educational category indicated that the health situation was either very bad or bad.



Source: Field Data, September 2012 – January 2013

When the health situation was examined with respect to occupation, Figure 5.14 showed that respondents from all sectors were generally of the opinion that the health situation was generally bad, with majority of respondents with an average of 50.3% in each sector indicating that the health situation was very bad or bad.

Figure 5.15: Condition of health during guinea worm epidemic by district



Source: Field Data, September 2012 – January 2013

When it came to what the health situation was like during the guinea worm epidemic by district it was found in Figure 5.15 that majority of respondents who thought the health situation was generally bad came from all districts with the following respondents in these districts indicating that the health situation was either very bad or bad: Nanumba South (91%), Nanumba-North (89.3%), Savelugu-Nanton (84.8%), Zabzugu-Tatale (78.4%), Yendi (78.4%), Kumbungu (75.3%), Gushegu (74.3%), East Gonja (72.2%), Central Gonja (69.1%), Karaga (68%), and Tolon (67.9%).

Table 5.2: Chi-square test on health during guinea worm epidemic

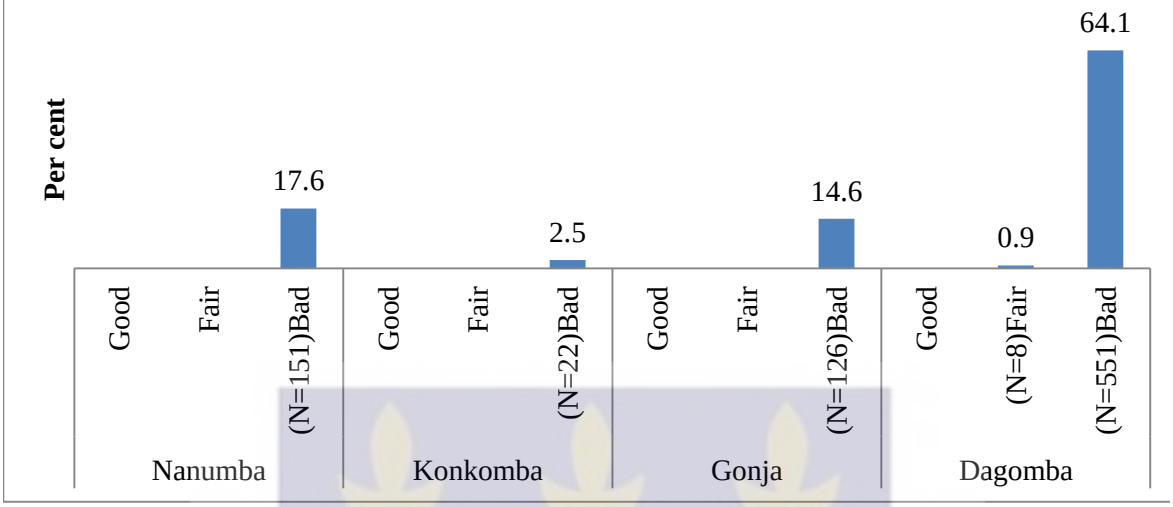
Variable	Value	df	Asymp. Sig
Respondent Category	653.356	572	.010
Age	38020.314	36036	.000
Gender	593.023	572	.263
Education	879.294	1144	1.000
Occupation	1743.683	1716	.315
District	6749.553	5720	.000

Source: Field Data, September 2012 – January 2013

The health situation during the guinea worm epidemic with respect to respondent category, age, gender, education, occupation, and district were subjected to Pearson's Chi square test to determine which of them are statistically related. The results are shown in table 5.2. At a significance level of 0.05 it was found that the health situation during the epidemic was significantly related to respondent category, age and district which had p-values less than 0.05. These indicate that the health situation during the epidemic was related to these variables.

The condition of health of the people during the epidemic was assessed by ethnic group. This was done by putting the views of the people according to the dominant ethnic groups in these districts, namely the: Nanumba, Konkomba, Gonja, and the Dagomba. The views that were received were evaluated under the following categories: good, fair, and bad. See Figure 5.16.

Figure 5.16: Condition of health during guinea worm epidemic by ethnic group



Source: Field Data, September 2012- December 2013

Plate 3: Deformities and incapacitation resulting from guinea worm

Source: Field Data, April 2015

It was overwhelmingly reported in Figure 5.16 from all the areas that the health situation during the guinea worm epidemic was bad (96.3%). This response was strongest in the Dagomba area with 64% of respondents attesting to the fact that the health situation during the guinea worm epidemic was bad. The weakest responses of the bad health situation came from the Konkomba area with 2.6%. There was some 0.2% of respondents in the Gonja area indicating that the health situation during the epidemic was fair. However, none of these areas indicated that the health situation during the guinea worm epidemic was good.

The Dagomba area described the bad health situation during the epidemic as a difficult situation in which many were affected. Damatu Atta, a 46 year old farmer made the following observation on how bad the health situation was at the time:

> "We were not healthy at all...guinea worm was selfish and greedy."
>
> Source: Extracts from FGD and Structured Questionnaire, Field Data, 2012

Joshua Allidu, a 37 year old driver, also commented on the bad health situation when he said:

> "We were in a very difficult situation. For instance, when a lactating mother's breast was affected it became a big problem."
>
> Source: Extracts from FGD and Questionnaire, Field Data, 2012

Other comments on the bad health situation worth reporting went like this:

> "The health situation in this community was such that almost 90% of the people were affected. Guinea worm was our major health problem by then";
>
> "We were healthy; but not healthy, because you will see work but can't work";
>
> "Our health status was not stable at that time."
>
> Source: Extracts from FGD and Structured Questionnaire, Field Data, 2012

Thirty six year old Rukaya Illiasu painted a gloomy and optimistic situation by saying:

> "Truly, infected people were not healthy; but those not affected were healthy. It was a mixed situation."

Source: Extracts from FGD and Structured Questionnaire, Field Data, 2012

Responses from the Gonja area described the bad health situation during the guinea worm epidemic in these words: guinea worm infection was very high; people were affected by guinea worm related diseases; there were other diseases like diarrhoea, malaria, etc; but, their effect on us was not as serious as the disease. People were always sick with one disease or the other. The health condition was unbearable because the disease had no cure in sight. All sorts of concoctions were administered to people who were ill with the disease. Despite these treatments guinea worm infections increased, making patients to suffer from illnesses related to the concoctions they took. Another respondent's statement on the bad health situation was as follows:

> "Though the health situation was not so good, the guinea worm disease brought worse conditions" and,
> "The health situation was not good because diseases that were related to the guinea worm set in as the guinea worm disease survived."

Source: Extracts from FGD and Structured Questionnaire, Field Data, 2012

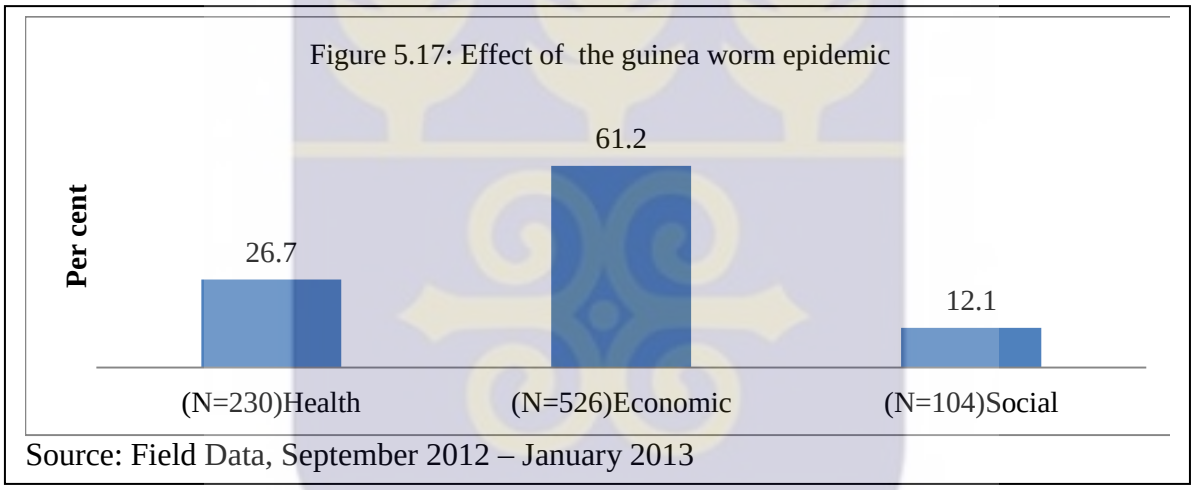
This situation as reported for the Gonja area was the same for the Nanumba endemic communities.

The situation as described for the Konkomba area was that guinea worm infectives had to sometimes lie in particular positions for a long time; this often resulted in rashes developing on their bodies. Guinea worm patients were afraid to eat because of the difficulties associated with going to toilet; and, some patients of the disease could go several weeks without taking

their baths. From the above discussion, it was established that the guinea worm epidemic had devasting effects on the health of the people in the Northern Region of Ghana. To sum it up, a general atmosphere of physical and psychological misery was perceived to have descended on the lives of people who lived in the guinea worm endemic areas, leaving the people with no or little hope of escaping from the epidemic.

5.5 Socio-economic impact of the guinea worm epidemic in the Northern Region

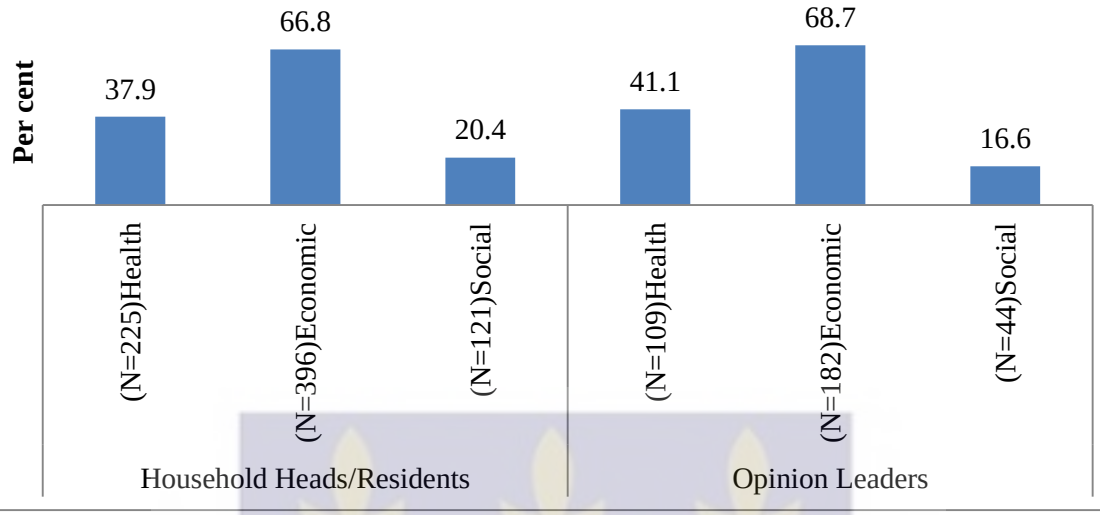
The research then turned its attention to find out from respondents how the guinea worm epidemic affected people's lives. The accompanying discussion below threw light on the topic which amplified the need to implement the GWEP.



Source: Field Data, September 2012 – January 2013

With regard to the effect of the epidemic on people responses in Figure 5.17 indicated that majority (61.2%) of respondents indicated that the epidemic affected them economically in the following ways: the disease retarded economic activities and people were unable to work. With regard to health about 27% of respondents indicated the disease made many people to suffer from poor health, thus making them suffer from immobility and deformities. Lastly, it was found that 12% of respondents indicated that the guinea worm epidemic affected them socially when they could not have access to potable water, school attendance for children was poor, relations between neighbours was strained, and development in communities being retarded.

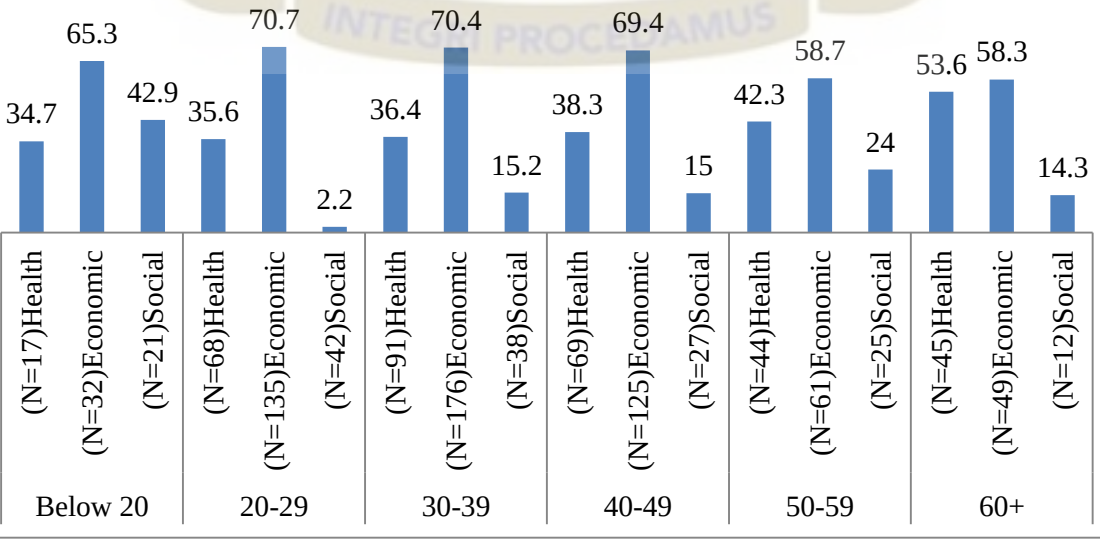
Figure 5.18: Effect of the guinea worm epidemic by respondent category



Source: Field Data, September 2012 – January 2013

On the issue of whether respondents could describe ways in which the guinea worm epidemic affected people the following responses in Figure 5.18 showed that 68.7% and 66.8% household heads and opinion leaders respectively and 41.1% and 37.9% opinion leaders and household heads respectively indicated that the epidemic had an adverse economic and health impact people. Fewer household heads (20.4%) and opinion leaders indicated the epidemic adversely affected them socially. This indicated that the guinea epidemic in the Northern Region was more of a health and economic problem than a social problem.

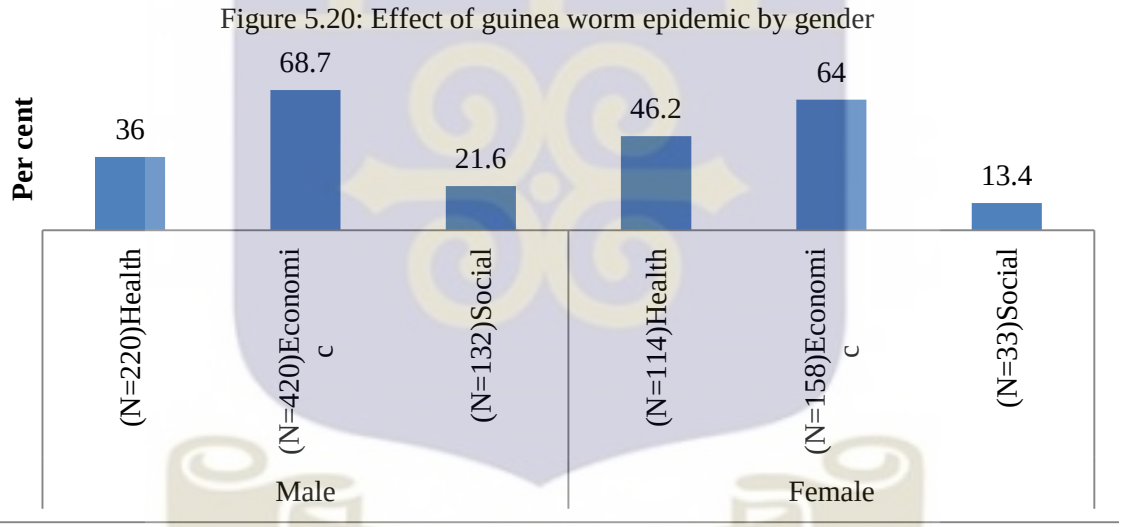
Figure 5.19: Effect of guinea worm epidemic by age



Source: Field Data, September 2012 – January 2013

The age of respondents was cross tabulated with ways in which the epidemic affected people in the community. Figure 5.19 showed an almost even distribution of the socio-economic effects of the epidemic across all age groups. However, respondents in the 60 years and above age group had majority of them indicating that the disease impacted adversely on the health of people because many were unhealthy and others suffered deformities. Respondents below the age of 20 aslo had majority (32.6%) of them indicating that the disease impacted adversely on the social welfare of people by retarding community development, people not having access to potable water, straining relations between people, and families using the demobilizing effect of the disease as an excuse for their children not attending school regularly.

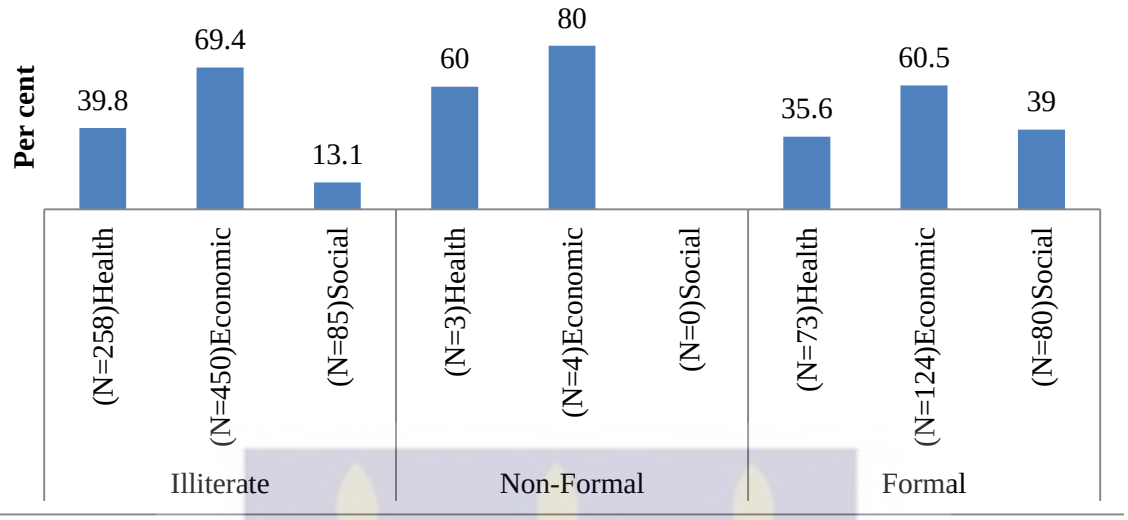
Figure 5.20: Effect of guinea worm epidemic by gender



Source: Field Data, September 2012 – January 2013

When sex of respondents was cross tabulated with respect to the various ways the guinea worm epidemic affected people in the community, Figure 5.20 revealed that most males (68.7%) and females (64%) thought the epidemic adversely affected them economically. This was followed by 46.2% females and 36% males indicating that the epidemic adversely affected them with respect to their health. The social effect of the epidemic came last with 21.6% males and 13.4% females indicating that the epidemic adversely impacted on their social lives.

Figure 5.21: Effect of guinea worm epidemic by education



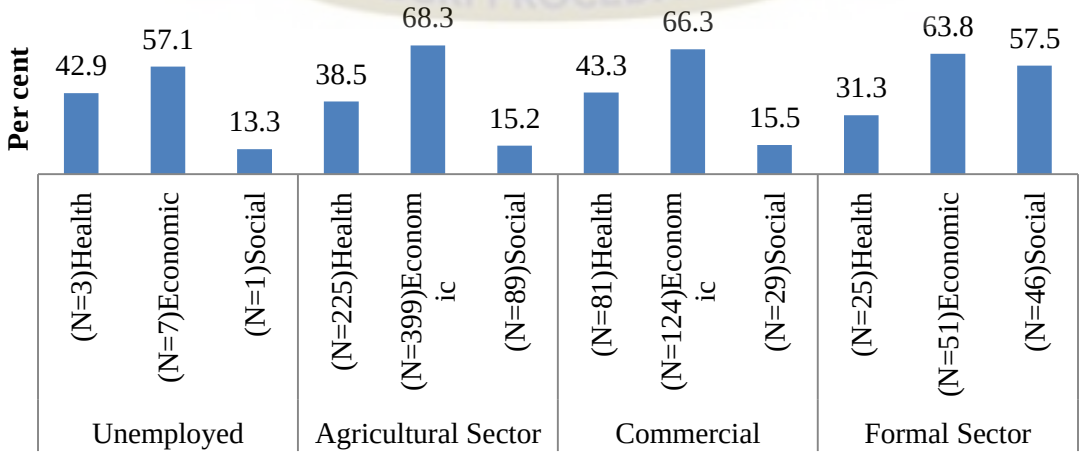
Source: Field Data, 2012

When education was cross tabulated with the various ways in which the guinea worm epidemic affected people Figure 5.21 revealed that respondents with non-formal education (80%), those without any form of education (69.4%), and those with formal education constituted the majority of those who indicated that the guinea worm epidemic adversely affected economic activities. Also 60% of respondents with non-formal education and approximately 40% illiterates indicated that the epidemic also had adverse effects on other aspects of their health.

: Stigmatization and chronic incapacitation resulting from guinea worm infection

Source: Field Data, April 2015

Figure 5.22: Effect of guinea worm epidemic by occupation



Source: Field Data, September 2012 – January 2013

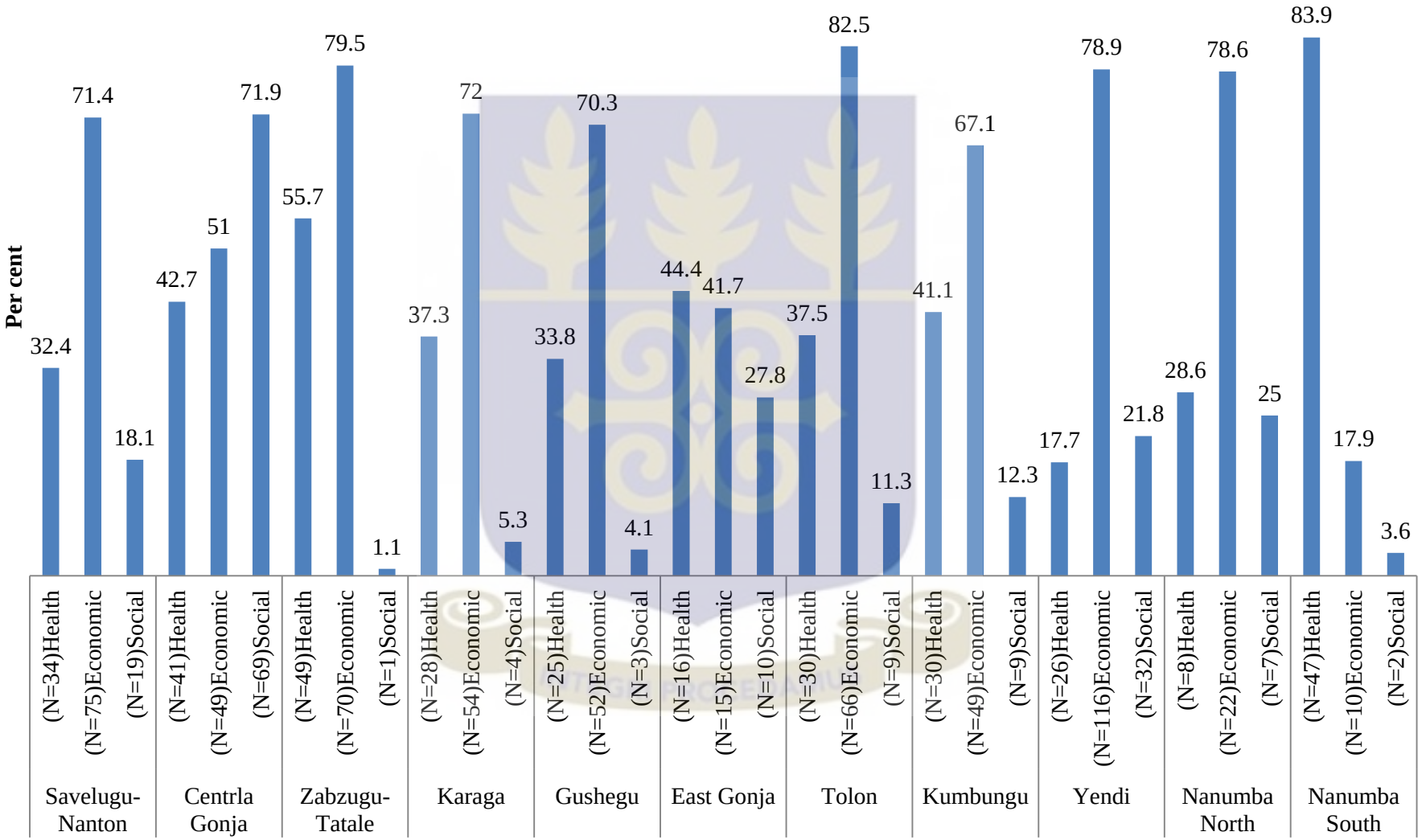
When occupation was cross tabulated with various ways in which the epidemic affected people Figure 5.22 revealed that respondents in the agricultural sector (68.3%), commercial sector (66.3%), formal sector (63.8%), and the unemployed (57.1%) indicated that the epidemic adversely affected their economic activities. Another 43% each of the unemployed and the commercial sector and 39% from the agricultural sector indicated the epidemic affected other aspects of their health. Lastly, 57.5% of respondents from the formal sector pointed to the fact that the epidemic adversely affected people's social wellbeing.

These statistical distributions were supplemented with the following views of respondents on the disease: the disease was an economic hazard which affected people in the productive age group. If the rest of the family was hit by the disease, then there was nobody to take care of them. The overall effect of the disease was that it had the potential to grinding the productive capacity of an entire family or community to a halt.

Also, the disease had the effect of making people to mix fact with fiction by trying to make others believe there were other ways of contracting GWD other than the empirical explanations that were assigned to the cause of the disease.

Figure 5.23 revealed that respondents from these districts: Tolon, Zabzugu-Tatale , Yendi and Nanumba North, Karaga, Savelugu, Gushegu indicated the epidemic adversely affected economic activities. Nanumba South and Zabzugu-Tatale indicated the epidemic affected their health. Respondents from Central Gonja indicated the epidemic was a social problem. These results indicate the epidemic was not only a health issue, but also a socio-economic problem.

Figure 5.23: Effect of guinea worm epidemic by district



Source: Field Data, 2012

Table 5.3: Chi-square test on socio-economic effect of guinea worm epidemic

Variable	Value	df	Asymp. Sig
Respondent Category	823.256	770	.089
Age	3906.576	3850	.258
Gender	807.275	770	.171
Education	1639.720	1540	.038
Occupation	2193.877	2310	.958
District	8371.850	7700	.000

Source: Field Data, 2012

The effect of the guinea worm epidemic with respect to respondents was subjected to Pearson's Chi square test to determine which variables are statistically related to how the epidemic affected the people. The test results are shown in table 5.3. At a significance level of 0.05 it was found that the effect of the guinea worm epidemic on people was significantly related to education and district because these variables have p-values less than 0.05.

Rosenfield et al (1984) have measured economic loss in communities that are affected by diseases by multiplying the number of days people are absent from work by their average daily incomes. This labour efficiency formula does not take into consideration the factor of peak and normal periods of labour, and does not take into consideration coping strategies that compensate for loss of labour and man hours in production. In peasant agricultural economies the number of days out of work does not necessarily mean a direct financial loss to the farmer or the affected family, as the occurrence of a sickness may not coincide with the planting and harvesting seasons. The duration of the illness may be short to enable the farmer to compensate for the number of hours he has lost to work (Kyereme, 1996). Some crops have flexible planting and harvesting dates and the disability level of the farmer may be such that the farmer is able to engage in farm work despite his illness (Brieger and Guyer, 1990).

The main factors that tend to impinge on the productivity of an affected individual are: duration of the disability and the level of severity of an infection (Kyereme, 1996). Kothari et al (1969) categorized the levels of severity of guinea worm infections into the following:

i. Severe, involving acute edema, erythema, ulcer, and swelling accompanied with severe pain and being incapable to engage in socioeconomic and household activities;
ii. Moderate, characterized by local swelling and ulcer with pain and disability that may permit the patient to engage in socio-economic and household activities; and,
iii. Mild, which involved local swelling and ulcer, the victim however, engages in normal socio-economic and household activities.

A Venn diagram analysis of the levels of severity of guinea worm infections using the Pardanani and Kale Indexes revealed that grade I infections by Pardanani et al (1977) and Kale (1977) have features and symptoms that are common to each other; however, grade II infections by Pardanani et al (1977) and Kale (1977) were found by the descriptions of both authors to be mutually exclusive. It was realized that that Pardanani et al's (1977) grade III and grade IV levels of severity of guinea worm infections were the same as Kale's grade III levels of severity. For the sake of easy analysis the Pardanani grade IV level of severity was absorbed into the Pardanani grade III level of severity of guinea worm infections.

It is hoped that this attempt to reclassify the levels of severity of the disease will give a simple and universal picture of how people were variously affected by the disease. Also it will make it possible to determine the socio-economic effects each type of severity had on individuals and whole communities. For example the socio-economic effect of grade I level of severity is not expected to be of a magnitude and scale similar to the grade IV level of severity. So that whereas people at the grade I level of severity are able to observe personal

hygiene and, engage in socio-economic activities that may not require physical exertion, those at the grade IV level of severity are completely incapable of taking care of themselves, let alone engage in any form of economic or social engagement, however, passive their involvement in that activity may be.

This was the economic and social importance that informed the reclassification of the Pardanani and Kale indexes into their simplest form. This is expected to give greater clarity to the socio-economic effects that each level of severity brought on individuals and their communities. It was as a result of the re-codification of the Pardanani and Kale indexes into a unified index that enabled the research to draw conclusions on the socio-economic effects of the disease by reviewing literature on, and examining, the effects of the disease on productivity (Kyereme, 1996) and parenting (Cleave, 1984). Table 5.4 illustrates the classification of the levels of severity of guinea worm infection, which affects socio-economic development in the Northern Region.

Table 5.4: Classification of severity of guinea worm infections according to the Pardanani and Kale Indexes

Pardanani Index		Kale Index	
Grade	Clinical Manifestation	Grade	Clinical Manifestation
Grade I	Pre-emergent stage – visible, palpable, subcutaneous worm; no acute inflammation.	Grade I	Pre-emergent stage – minimal discomfort
Grade II	Minor inflammation – ulceration with or without worm protruding.	Grade II	Severe discomfort – ability to engage in limping movements
Grade III	Secondary bacterial infection resulting in disability – abscess, ulcer, edema, cellulitis with or without malaise.	Grade III	Severe discomfort – completely immobile
Grade IV	Severe manifestation, acute deformities, pronounced disability		

Source: Developed from Kyereme, 1996

The notable socioeconomic impacts of the guinea worm epidemic on the lives of the people living in the Northern Region were found to include the following: pain and immobility, obstruction of business, dependence on open water bodies, depressed socio-cultural activities, frequent illness, misery and despondency, labour loss, poor school attendance, suspicion, low crop yield, post harvest losses, and death threatening situations due to guinea worm related infections. The details of these effects are discussed below.

5.5.1 Pain and immobility

As a result of the guinea worm epidemic in the Northern Region of Ghana there were a number of health, economic, social, and environmental consequences that the disease wrecked on the guinea worm endemic districts of the region. The leading health effect of the guinea worm epidemic was immobility, with some 16.5% of respondents indicating that the immobilizing effect of the disease was what worried them most. This complaint came mainly from the Nanumba and Dagomba area, where some 10% and 5.2% respectively, described the pain and immobilizing effect of the disease as a disease that cuased general discomfort, immobilized people for close to three months, made others unable to walk long distances, thus preventing them from being able to go to their farms during the farming season. The following responses from the Dagomba area, which are worth reporting, give ample evidence of the immobilizing effect that the guinea worm epidemic had on the people of the guinea worm endemic districts of the Northern Region:

> "It could make you stay indoors for more than three months; people had to support themselves with walking sticks."

Source: Extracts from FGD and Structured Questionnaire, Field Data, 2012

A 62 year old farmer and a 63 year old trader had this to say respectively:

> "Guinea worm affected my leg making me to be limping" and
> "It crippled me; one even came through my breast. I could not do any work." (President Jimmy Carter told no lie when he said he saw a worm emerge from a woman's genitals here in Ghana).
>
> Source: Extracts from FGD and Structured Questionnaire, Field Data, 2012

A 20 year old farmer and a 24 year old trader and an unidentified respondent also had this to say about the immobilizing effect and pain the disease caused:

> "I was [immobilized] for about two years" and "any time you visit the hospital ward you see them crawling and looking helpless."; and,
> "I was a victim and it is very painful."
>
> Source: Extracts from FGD and Structured Questionnaire, Field Data, 2012

This 35 year old farmer summed up the total effect of the pain and immobilizing effect of the guinea worm epidemic on their guinea worm endemic communities in the following words:

> "You can see that everyone has gone out to struggle for something; [but] in those days people were always indoors."
>
> Source: Extracts from FGD and Structured Questionnaire, Field Data, 2012

5.5.2 Disruption of business

Closely following on the heels of immobility was the fact that the disease made it difficult for them to engage in economic activities. Some 16.3% attested to this fact, with majority coming from the Dagomba and Nanumba areas with some 7% and 6% respectively of respondents attesting to this fact. Some respondents in the Dagomba area described the effect of the disease on their economic activities by indicating that "guinea worm was a selfish disease" that prevented people from going to work; that is, to harvest firewood, sheanuts and, engaging in sheabutter production. A 48 year old farmer and food vendor in the Dagomba

area of Kumbungu had this to say on the effect of the disease on his ability to work and earn income:

> "It rendered me worthless because I could not go to the farm to farm; I could not do anything meaningful with myself. As a woman I could not go out to pick sheanuts" and "you could not go out to harvest dawadawa to make ends meet."

Source: Extracts from FGD and Structured Questionnaire, Field Data, 2012

Added to the effect of the disease in disrupting business stated by a 40 year old woman from the Dagaomba area of Yendi who said:

> "It really burdened us; because if you are three wives to a man and the two were infected the one left was doomed."

Source: Extracts from FGD and Structured Questionnaire, Field Data, 2012

In the Nanumba area it was generally reported that farming was disrupted as work did not progress smoothly. Furthermore, those who moved into trading ventures suffered the set back of their businesses collapsing because the rainy season was the time most people were immobilized by the worm. As a result affected people earned little or no incomes. In the Gonja and Konkomba areas some 2.4% and 0.5% respectively of respondents indicated that the epidemic disrupted their businesses in a similar way.

5.5.3 Depressed socio-cultural activities

Another effect the research found was that the guinea worm epidemic caused a slowing down of socio-cultural activities in the guinea worm endemic areas. Some 10.6% of respondents indicated that the disease caused socio-cultural activities to slow down. These respondents came from the Gonja, Dagomba, and Konkomba areas with 8%, 2.2%, and 0.3% respectively of respondents indicating that the guinea worm epidemic was responsible for socio-cultural activities not being interesting for affected people. Family gatherings were not patronized

effectively. A 51 year old farmer and a 35 year old smock weaver respectively made these observations on the subject:

> "If I want to talk about it (the guinea worm epidemic) day will break...women could not marry;" and,
> "It prevented me from wearing my smock."

Source: Extracts from FGD and Structured Questionnaire, Field Data, 2012

5.5.4 Frequent illness

There was the added effect of the epidemic making residents of guinea worm endemic areas to regularly get ill. This effect had some 07.9% of respondents indicating that the epidemic made them to regularly get ill. In this category of responses some 5.2% from the Konkomba area, 1.4% and 1% from the Gonja and Nanumba areas respectively, and 0.3% from the Dagomba area cited frequently getting ill as one of the effects the disease had on they and their people. Putting their responses together it was possible to capture their views on people frequently falling ill by saying that during the time when the guinea worm epidemic was in existence there were a lot of health problems; it was a seasonal sickness that made people ill during the farming season. Secondly, because they were ignorant of what caused the disease people constantly fell ill, and spent the little money they had for treatment.

5.5.5 Misery and despondency

An effect that came under the notice of the research was the misery and despondency that the people of the former guinea worm endemic areas suffered. In this regard some 3.5% of respondents from the Dagomba Traditional Area, the Gonja Traditional Area, and the Konkomba Traditional Area, averred to the fact that there was a general atmosphere of misery in houses when somebody was taken ill with the disease. Respondents views on their miserable situation during the guinea worm epidemic were packaged and presented as follows:

> "There was a general atmosphere of misery among us because some were immobilized, preventing those who could work from working the way they should have worked." "Victims of the disease", one respondent said, "had to suffer until God relieved them of it."

Source: Extracts from FGD and Structured Questionnaire, Field Data, 2012

Respondents from the Konkomba area described the situation by saying that patients of the disease either lay on their stomachs, or on their backs, and others had to sit for most of the time because the worm hung from other parts of their bodies:

> "There were times when the worm affected people on their tongues "; and "it burdened people because if you had a problem or work and people were to support you, but are down with guinea worm they can't help you."

Source: Extracts from FGD and Structured Questionnaire, Field Data, 2012

In describing the misery that the guinea worm epidemic caused, a respondent from the Dagomba area of Gushiegu threw in this alarming comment during this period of pre-certification when he said:

> "An infected person could be a pathetic sight. I have guinea worm but it has not yet come out."(Awal Mohammed, 37, Driver).

Source: Extracts from FGD and Structured Questionnaire, Field Data, 2012

A respondent also shed light on the effect the guinea worm epidemic had on people who did not suffer any infection of the disease:

> "Though I was not infected I suffered more because I had to carry infected people to defecate and go alone to the farm." (Farmer, 55)

Source: Extracts from FGD and Structured Questionnaire, Field Data, 2012

5.5.6 Poor school attendance and susperstition

Some other effects that the guinea worm epidemic brought on the people of the guinea worm endemic areas were poor school attendance (2.4%). Other respondents (2.2%) indicated the epidemic caused conflicts because people suspected others for being responsible for their predicament. This resulted in family relationships between people being strained. A

respondent from the Nanumba area said the disease like any other disease was put on old ladies who are said to have caused it.

5.5.7 Mortality

A few of the respondents from the Dagomba area felt the guinea worm epidemic resulted in loss of lives. Two respondents expressed this view by indicating that illness from the disease resulted in loss of life. Mortality from guinea worm infections, the world over is known to be a rare occurrence (Adeyeba, 1985). The observation by this group though possible may not be a true reflection of the epidemic on the lives of the people taking into consideration the fact that some of them are in the early stages of their adulthood. One who gave this response was a 20 year old butcher who attained maturity at a time the programme had created awareness on the disease, and had in place sophisticated medical expertise to handle serious cases of guinea worm infections and worm extraction. So, deaths from the disease, as these young ones have reported, most likely did not occur.

5.5.8 Low crop yield and post harvest losses

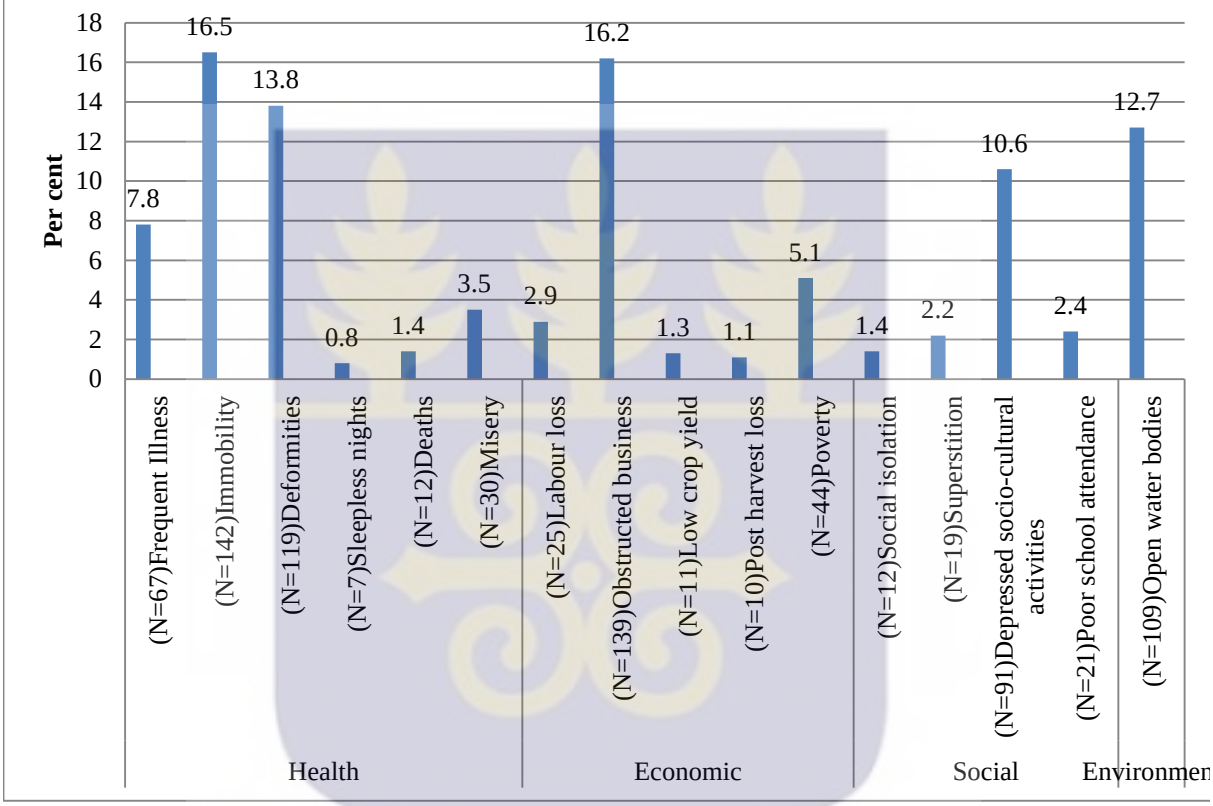
Some also indicated that the epidemic had resulted in low crop yield and post harvest losses respectively. Some of the responses that were captured in this regard was "agricultural activities yielded low results in the guinea worm endemic communities of this district," affected farmers often got low crop yield as a result of their inability to give their farms the needed attention, and they could not pick enough sheanuts. This was more so in the Nanumba and Dagomba areas in which respondents registered post harvest losses as one of the effects the epidemic had in the region. This was because farm produce got wasted on farms, and eventually got destroyed by being exposed to the elements and bushfires. A 35 year old driver and farmer described this effect by saying:

> "When it was harvesting time you could not go and harvest, then bushfires would consume the crops."

Source: Extracts from FGD and Structured Questionnaire, Field Data, 2012

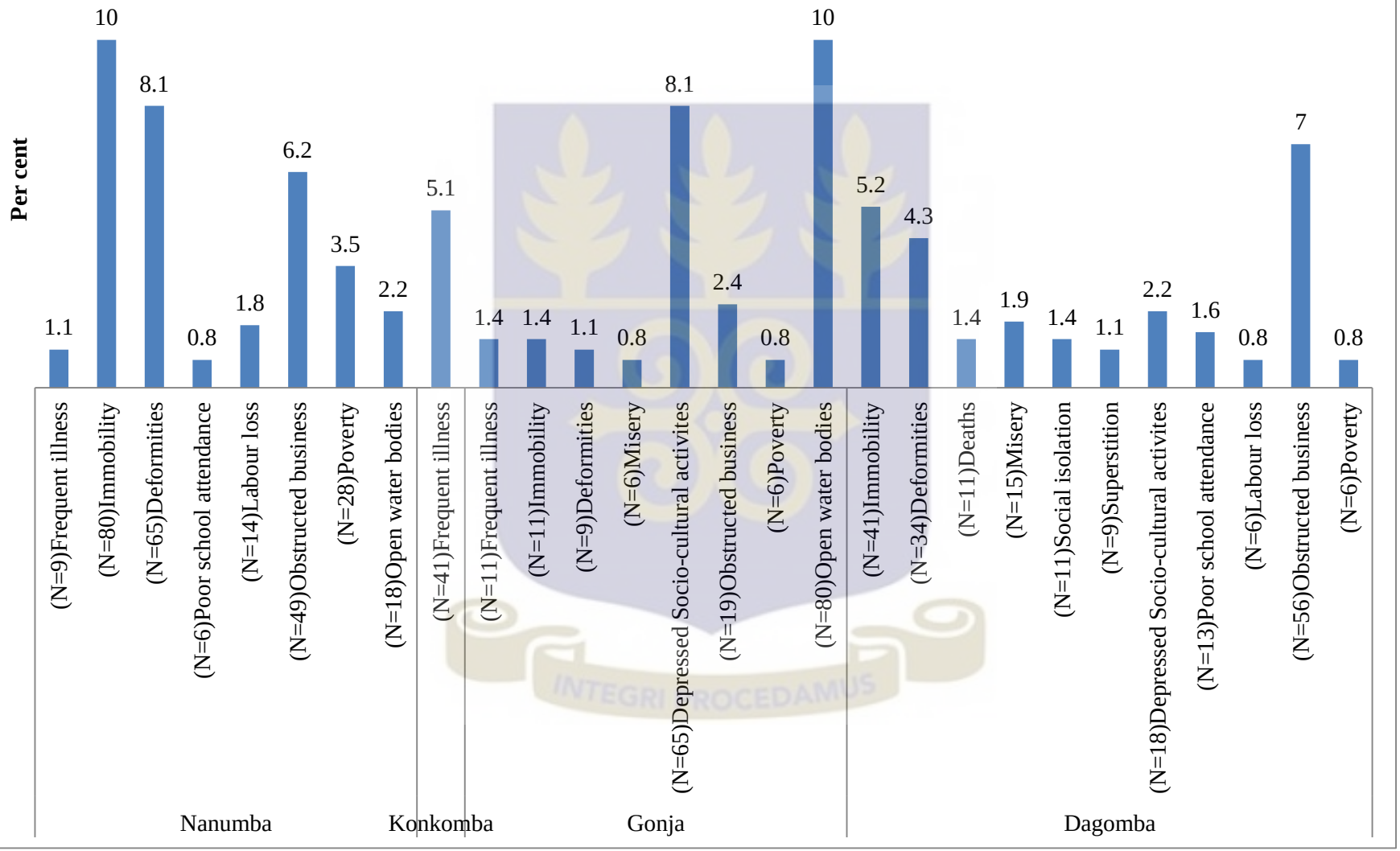
This was confirmed by women who said they lost shea nut because strong when women were immobilized by the disease children were left with the task of gathering shea fruit and were scared off by grown ups. Figures 5.24 and 5.25 shows the effects of the epidemic on the lives of people of the guinea worm endemic areas of the Northern Region.

Figure 5.24: Effect of guinea worm epidemic in Northern Region



Source: Field Data, September 2012- December 2013

Figure 5.25: Effect of guinea worm epidemic by ethnic group



Source: Field Data, September 2012- December 2013

5.6 The wider implication of the guinea worm epidemic on health and socioeconomic development

Chambers (1979) realized that the rainy season was the most exacting time of the year because the risk of an increase in guinea worm infections, threatened the availability of agricultural labour, the quality of child care and nutrition, which results in poor health. Chambers observed that there was a relationship between malnutrition during the pre harvest season and the occurrence of the disease in the rainy season. Waddy (1956) made the same observations of dracunculiasis infection and malnutrition during the pre harvest and rainy season in Ghana.

GWD undoubtedly drew back the socioeconomic development of communities in which the disease was endemic. The active labour force was constrained either by being directly infected with the disease or indirectly, by taking up additional household and economic tasks which had the effect of lowering productivity.

School attendance was irregular and partly attributed to the epidermic. Child care was delegated to other family members when mothers fell victim to the disease. As a result the building blocks of affected communities – health, education and agriculture – were threatened with regard to the quality of the performance of these services. The basic unit of communities (households) was driven to the point of resigning themselves to the fate of the cyclical effects of guinea worm infections, with little hope of escaping from the disease and the wider socioeconomic effects the disease brought along with it.

It was in the wake of these devastating effects of the guinea worm epidemic that the Government of Ghana launched the Ghana GWEP in 1988, resulting in it becoming operational that same year in the country.

CHAPTER SIX

THE GUINEA WORM ERADICATION PROGRAMME IN THE NORTHERN REGION

6.1 Introduction

This chapter addresses the third objective and the second proposition of the research; which are: "examine the operations of the GWEP in Ghana, and the Northern Region in particular" and, "the GWEP was effective only at the district level of health care delivery", respectively.

Closely connected to this objective and proposition was the test of the hypotheses of the research to determine the factors that were responsible for the eradication of the disease in Ghana, and the Northern Region in particular. In this regard the null and alternate hypotheses that were tested with respect to the research were:

> H° - Increase in the provision of potable water did not cause a significant decrease in the number of cases of guinea worm infections; and,
>
> H^{1} - Increase in the provision of potable water caused a significant decrease in the number of cases of guinea worm infections.

The third objective and its accompanying second proposition was addressed by examining the operations of the programme at the national, regional, and village levels of prevalence and intervention between 1989 and 2010, to uncover the progress the programme made over the years to curb the guinea worm epidemic. This paved the way for the research to assess the progresse the programme made in order to achieve its objective, and determine the effects it had on socio-economic development and behavioural changes of the people towards the disease.

6.2 An overview of the GWEP in Ghana

The objective of the GWEP in Ghana and the world at large was to eradicate guinea worm as a major public health disease and as an obstacle to socio- economic development and, ensure that participating countries are capable of maintaining this achievement (Cairncross et al 2002; WHO, 1994).

In March 1988, the Second African Conference on guinea worm eradication was held in Accra, Ghana. This conference marked the beginning of Ghana's effort at the global level to eradicate the disease in the country. It was at this conference that the Government of Ghana and Global 2000, an extension of the Carter Foundation, signed a memorandum of understanding aimed at eradicating the disease in Ghana. Later in the year a plan of action was outlined indicating what was to be done to eradicate the disease. Ghana's Ministry of Health and Global 2000 were tasked to coordinate the activities of participating agencies. The preliminary arrangements paved the way for Ghana to embark on its effort to start eradicating the disease, in 1989 (CDC, 1987, 1988).

With the GWEP becoming operational in 1989 a case search to establish the severity of the guinea worm epidemic was conducted. The search was able to establish the number of cases of guinea worm infections and the number of communities in Ghana that had come under the plague of the guinea worm epidemic. With this knowledge in mind the GWEP and Global 2000 started pursuing the objective of eradicating GWD from Ghana by the year 1995. This chapter examined the GWEP in Ghana and how it influenced the eradication of the disease from the country and, the endemic communities of the Northern Region in particular (CDC, 1988; 1989).

The method for eradicating the disease was based on educating patients to come to the realization that the disease was the result of drinking water that was contaminated with the guinea worm cyclops; and that the responsibility of preventing further infections of guinea worm lay largely on them. The programme was implemented at the village level by appointing an unpaid village representative who was trained to provide health education, distribute cloth filters, and record and report monthly cases of guinea worm infection which occurred in the village (CDC, 1989).

Monthly reports of cases of guinea worm infection started in 1991. Cases of guinea worm infection were reported from the village to the national level in a hierarchical chain of command. This is how it was done: from the village level to the zonal level, then to the district and regional levels and, finally ended up at the level of the National Secretariat of the programme (CDC, 1991).

A village was said to have achieved "on time reporting" of cases of guinea worm infections when the report was made within twenty days after a month ends. By 1992 the programme had achieved a 90% "on time reporting record", and was improved upon in 1993 to approximately 99% (Kyereme, 1996).

The basic health education message that the programme sent into guinea worm endemic communities was "the need to protect their sources of drinking water from being contaminated by an infected person and, cultivating the habit of sieving, filtering, and boiling their water before drinking." In 1993 Global 2000, and two other American companies, Dupont and Precision Fabrics donated 1200 000 nylon cloth filters and an assortment of educational aids, in the form of films, posters, pamphlets, flipcharts, teaching manuals, and

handouts to Ghana. This was meant to enhance the programme's measures aimed at preventing further infection of people with guinea worm by educating them to adopt safe water treatment habits (Kyereme, 1996).

Vector control and worm extraction were subsequently included in the programme's measures that were aimed at preventing guinea worm infections. The programme used vector control as a preventive measure by treating drinking water sites every month with a chemical called Abate. Abate is harmless to humans; but it stifles the development of the intermediate host of the worm, which is the water flea. Here again, Global 2000 managed to get another American firm, American Cynamid to supply Abate free of charge to Ghana (CDC, 1989).

The extraction of the worm was a surgical technique that was developed in India. As a result UNICEF contracted an Indian Physician to train Ghanaian public health physicians on how to extract the worm from patients without causing further injury to them. As a result of UNICEF's initiative each guinea worm endemic district in Ghana had at least one person trained in the techniques of worm winding out (Rohde et al, 1993; CDC, 1989).

Towards the last quarter of 1992, the GWEP instituted an accelerated prevention model called case containment (CDC, 1992). The principle that governed the concept of case containment was "no further spread of GWD should result from any case that occurs." The principle required that each case of guinea worm emergence is managed by giving it the local attention that it deserves (Kyereme, 1996). Case containment greatly revolutionized the preventive aspect of the GWEP because it called for extensive training and conscientizing programme staff and volunteers. The operating standard for case containment was that all cases of guinea worm infection must be reported within 24 hours of worm emergence. The

worm is surgically extracted if it becomes necessary to do so. When worm emergence does not call for surgical extraction, then the area of guinea worm emergence is immersed in water to facilitate the smooth and complete removal of the worm from the human host. With the complete emergence of the worm from the human host taking place occlusive bandage is applied to the appropriate limb of the patient to prevent larvae from being liberated into sources of drinking water (Kyereme, 1996).

Towards the last quarter of 1994 the programme tried to put every guinea worm endemic village in Ghana under the case containment strategy. The programme tried to do this by anticipating where worm emergence was likely to occur for health workers, and communities which were likely to be affected to be prepared before actual emergence of worms took place. As at 1994 the programme extracted 882 worms from people who were infected with guinea worm. The total number of reported cases for the year (1994) was 5 751. The programme bore the cost of caring for every reported case of guinea worm infection (CDC, 1994, 1995).

As a result of absorbing the cost involved in the case containment strategy, the programme got an impressive response from affected communities. This came in the form of village volunteers and community members taking it upon themselves to encourage each other not to rely on their local knowledge of worm winding out. They should take advantage of the case containment strategy, for the programme to eliminate the possibility of surface sources of water supply being re-infected with the copepod of the disease. It was therefore felt by some community members that one of the contributory factors of the GWEP that led to a sustained avoidance of coming into direct contact with surface sources of drinking was the successful introduction of the case containment strategy to complement the conventional methods of intervention (CDC, 1989).

The activities of the Ghana/GWEP have resulted in the programme progressively reducing the incidence of guinea worm infections and progressively decreasing the prevalence rate of reported cases of guinea worm cases to zero (CDC, 2012, 2013).

Incidence is the recorded percentage of new cases of disease occurrence within a year. When transmission of a disease is stopped incidence is reduced to zero. Prevalence is the per centage of individuals who host a disease parasite in a population. It is a composite indicator which combines incidence with patient recovery, population migratory movements, decreases in the number of patients, and the coming up of a young and healthy population. Prevalence therefore shows the amplitude of parasitic infections in a given population (WHO, 1974).

Since incidence of a disease was found to be a subset of the prevalence rate of a disease the research relied on prevalence rates of guinea worm infections to examine the effect of the programme on the levels of guinea worm infectivity in Ghana and the Northern Region in particular. Before the programme started work in Ghana the prevalence rate was as high as 85.8% in the Northern Region as compared to 14.2% for the rest of the country.

In the programme's attempt to free the country of the disease rapid progress was made, between 1989 and 1994, to reduce the number of reported cases of guinea worm infection from 179,556 in 1989 to 8 432 in 1994, thereby reducing the number of reported cases of guinea worm infections by 171 124 cases or 95.3%. During the early years of the programme (1989-91) appreciable progress was made when the number of reported cases of guinea worm infections reduced by 31.1% and 31% for the 1989-90 and 1990-91 health periods respectively. Between 1991and 1992 the number of reported cases of guinea worm infections was further reduced by another 18.5%. This trend in the reduction in the number of reported

cases of guinea worm infections continued to 1994 with the number of reported cases reducing by 8.7% and 5.3% during the 1992-93 and the 1993-94 health periods respectively. The uninterrupted significant reductions in the number of reported cases of guinea worm infections in Ghana between 1989 and 1994 respectively, seemed to suggest that the GWEP was set to achieve the WHA feasible objective of eradicating the disease by the end of 1995 (CDC, 1992).

However, the programme experienced a series of setbacks and gains during the 1994-95 and the 2005-06 health periods as a result of registering fluctuating increases and decreases in the number of reported cases of guinea worm infections over the previous year, which was the 1993-94 health period. The number of reported cases for the 1994-95 health period was 8 894, while that of the previous year (1993-94) was 8 432 cases, which represented a 0.3% increase in the number of reported cases over the previous year. This reversal of progress in achieving the goal of the WHA of eradicating the disease in Ghana by the end of 1995 during the 1994-95 health period suggested that the programme was to realize the WHA's objective of eradicating the disease in Ghana at a later date (CDC, 2007).

The programme managed to correct the setback of increased reported cases of guinea worm infections during the 1994-95 health period by reducing the number of reported cases of guinea worm infections by some 2.2% in the 1995-96 health period. The progress that was made in the 1995-96 health period was reversed in the 1996-97 health period when the number of reported cases of guinea worm infections increased by 2.3%. The programme was able to make a modest gain in the 1997-98 health period when it reduced the number of reported cases of guinea worm infections by some 1.9%. In the 1998-99 health period the number of reported cases of guinea worm infections shot up to 9 027 cases thereby increasing

the number of reported cases of guinea worm infections by some 2%. During the 1999-2000 and 2000-01 health periods the number of reported cases of guinea worm infections reduced by 0.9% and 1.5% respectively; but these gains were slightly eroded and deepened further between the 2001-02 and 2002-03 health periods when the number of reported cases of guinea worm infections was increased by 0.5% and 1.5% respectively. The losses that were sustained during these health periods (2001-02 and 2002-03) were pushed back between the 2003-04 and 2004-05 health periods by reducing the number of reported cases of guinea worm infection by 0.6% and 1.8% respectively. The disease was, however, able to inflict a slight injury to the programme's effort at eradicating it during the 2005-06 health period by registering a 0.8% increase in the number of reported cases of guinea worm infections (Ghana/GWEP, 2012).

It was, however, after the 2005-06 health period setback of the programme's effort against the disease that the programme registered sustained gains at reducing the number of reported cases of guinea worm infections and progressively reduced it to zero cases towards the middle of the 2010-2011 health period. The health periods after the 2005-06 health period were the periods between 2006 and 2011. It was between these health periods that the number of reported cases of guinea worm infections reduced progressively from 0.4% during the 2006-07 health period to zero cases of guinea worm infections in 2011 (Ghana/GWEP, 2012; CDC,2013).

The success of the 2008-09 and the 2009-10 health periods, when the number of reported cases of guinea worm infections reduced drastically from 242 cases to 08 cases (GHS, 2010), indicated that the programme's campaign against the disease in Ghana was coming to a successful end. The programme recorded zero cases of guinea worm infections in the 2010-

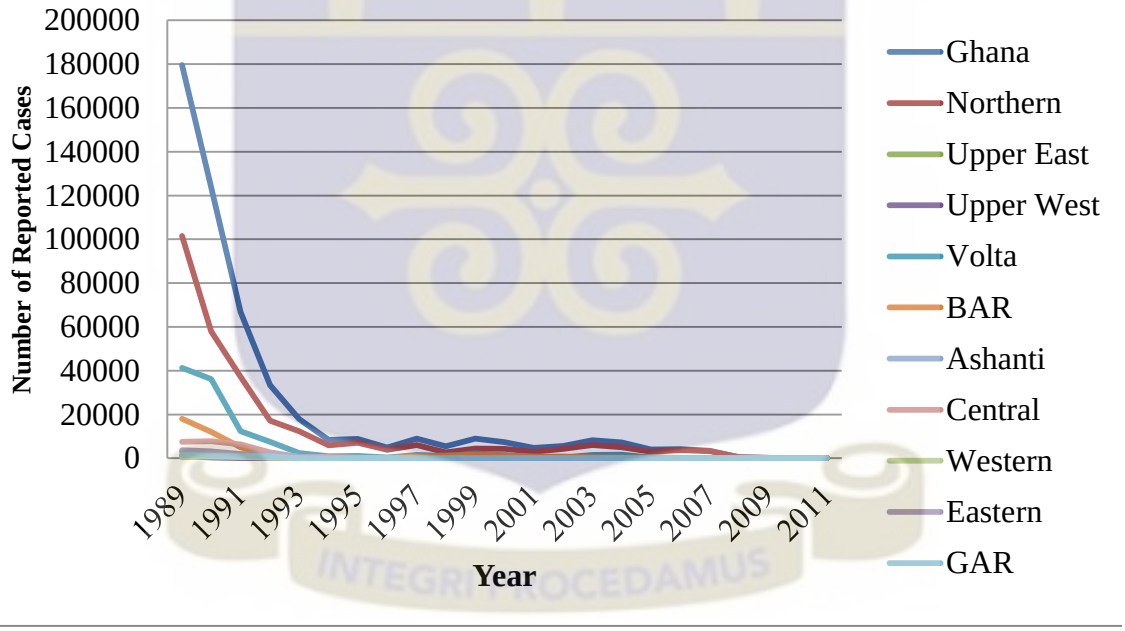
2011 health period. This record of the programme during the 2010-2011 health period set the stage for the programme in Ghana to begin the end of its operations in the country. The programme was able to eventually realize the WHA's objective of eradicating the disease by recording its last cases of guinea worm infections in July 2010 (GHS, 2010; GHS/GWEP, 2012). Between January 2010 and May 2010 the last cases of guinea worm infections in Ghana were recorded in the Northern Region of Ghana. Starting from June 2010 to date not a single case of guinea worm infection has been recorded in Ghana (GHS/GWEP, 2012). If this trend of no suspected case of guinea worm infection should continue to the end of December 2013 Ghana would be considered to have successfully passed the test of eradicating GWD.

From the above analysis it can be seen that even though Ghana was a hyper endemic country of guinea worm infection, the national situation was influenced by the endemicity pattern of the disease in the Northern Region. This is illustrated in Figure 6.1 where the prevalence pattern for the Northern Region and the overall national prevalence for the period between 1989 and 2011 follow a similar pattern. That for the other regions, except the Volta Region which came a little close to the patterns of the Northern Region and the overall national pattern, did not conform with the overall national pattern of prevalence. Nonetheless, these regions harboured the disease at hyper endemic and meso endemic levels, thus making GWD a disease of public health importance in the country. What this pattern meant was that the description of Ghana as a hyper endemic focus of guinea worm infection was largely influenced by the prevalence rates of the disease in the Northern Region.

In this regard the Northern Region was the bedrock on which Ghana became a guinea worm endemic country in Africa, and the foundation on which Ghana committed resources to ascertain the level of severity of the disease for the local and global initiative to eradicate the

disease to be implemented in the country. Therefore, when Ghana started bringing the disease under control the Northern Region was the region that recorded the last cases of guinea worm infections in the country. The Northern Region was therefore closely monitored to detect a single case of guinea worm infection. If any case was found, this could suggest that there may be other cases of guinea worm infection in the rest of the country. So, the alarm bells for the presence of a full blown guinea worm epidemic, the clarion call for the GWEP to be implemented, and the eventual eradication of the disease in the country can be said to have started and ended in the Northern Region.

Figure 6.1: Reduction in cases of guinea worm infections in Ghana:1989-2011



Source: National Secretariat, GWEP, Tamale, 2012

The trend of the number of reported cases of guinea worm infections in the Northern Region followed the same pattern for the overall Ghanaian situation of the number of reported cases of guinea worm infections from the beginning of the programme until the last cases of guinea worm infections were recorded in the country. The region had the highest prevalence rate (56.5%) of confirmed cases of guinea worm infections as compared to the rest of the country,

which had an average prevalence rate of 4.8% of confirmed cases of guinea worm infections for each region, when the programme was started in 1989. It was therefore the high prevalence rates of confirmed cases of guinea worm infections in the Northern Region that made Ghana one of the hyper-endemic foci of the disease in Africa. Table 6.1 gives a summary of the prevalence rates of guinea worm infections in the Northern Region and the rest of Ghana (all functional regions save the Northern Region of Ghana) between 1989, the year the programme started, and 2011, when no reported case of guinea worm infections was recorded in the country.

Table 6.1: Prevalence rates of guinea worm infections in Ghana: 1989 – 2011

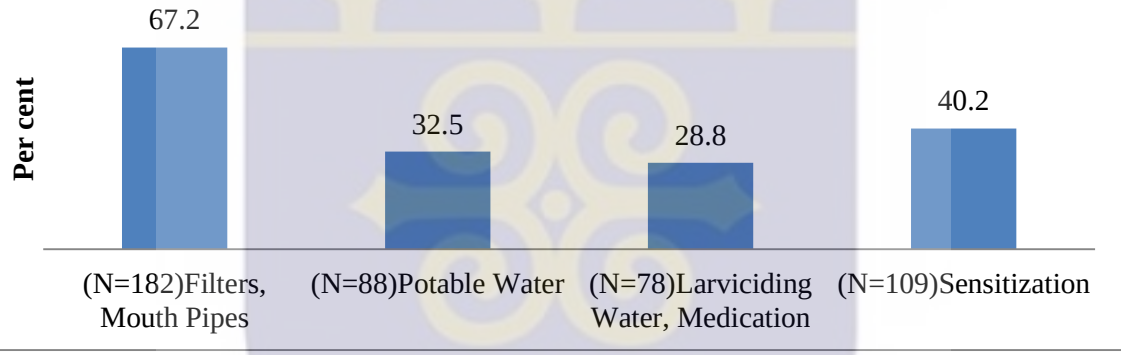
Year	Prevalence Rate		Average Prevalence Rate	Per cent (NR+RG=100)
	Northern Region (NR)	Rest of Ghana (RG)	Rest of Ghana (RG/9)	
1989	56.54	43.46	4.83	100
1990	46.86	53.14	5.90	100
1991	55.75	44.23	4.92	100
1992	51.23	48.78	5.42	100
1993	69.04	30.96	3.44	100
1994	69.40	30.60	3.4	100
1995	80.01	19.99	2.22	100
1996	80.01	19.99	2.22	100
1997	67.13	32.87	3.65	100
1998	49.42	50.58	5.62	100
1999	48.59	51.41	5.71	100
2000	58.38	41.62	4.62	100
2001	61.81	38.19	4.24	100
2002	85.27	14.73	1.64	100
2003	72.36	27.64	3.07	100
2004	68.44	31.56	3.51	100
2005	74.88	25.12	2.79	100
2006	88.95	11.05	1.23	100
2007	96.40	3.60	0.4	100
2008	95.61	4.39	0.49	100
2009	97.93	2.07	0.23	100
2010	100	0	0	100
2011	0	-	-	-

Source: National Secretariat, GWEP, Tamale, 2012

6.3 Operations of the GWEP in the Northern Region

The third objective that guided the research was the examination of the operations of the GWEP in its effort to eradicate the disease. It was found that the major activities the programme pursued to achieve its objective of eradicating the disease in the region were: managing unsafe sources of water supply, collaborating with the primary health care system of the GHS to achieve the programme's objective of eradicating the disease, seeing to the provision of safe sources of drinking water, pursuing health education programmes to impart knowledge on how to avoid the disease. Respondents were therefore asked to indicate the activities the programme pursued to eradicate the disease.

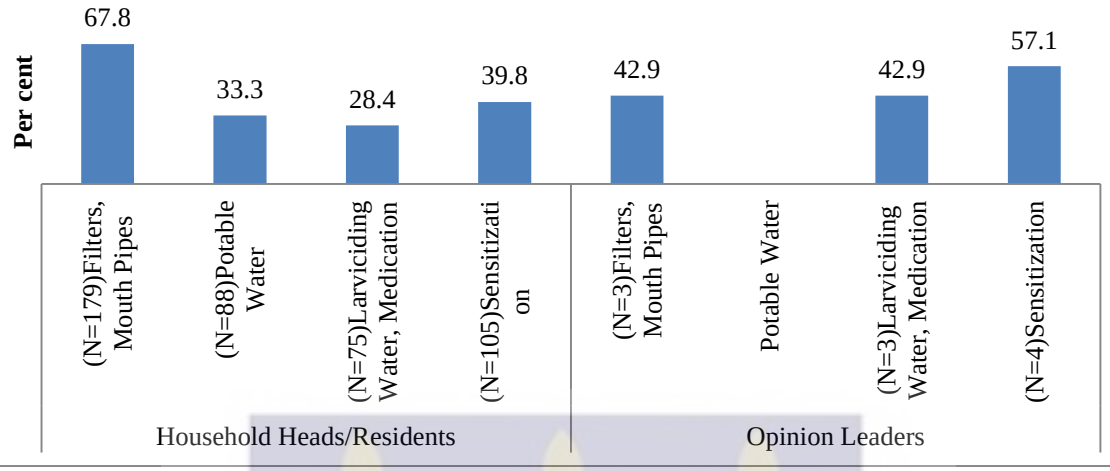
Figure 6.2: Activities of GWEP in Northern Region



Source: Field Data, 2012

Some 67.2% of respondents in Figure 6.2 indicated the programme carried out their operations in the region by providing filters nets and mouth pipes. This was followed by 40.2% saying the programme carried out sensitization programmes. Another 32.5% indicated the programme provided potable water, and 28.8% indicated chemicals were put in their surface sources of drinking water, and medication was administered to people who were infected with guinea worm.

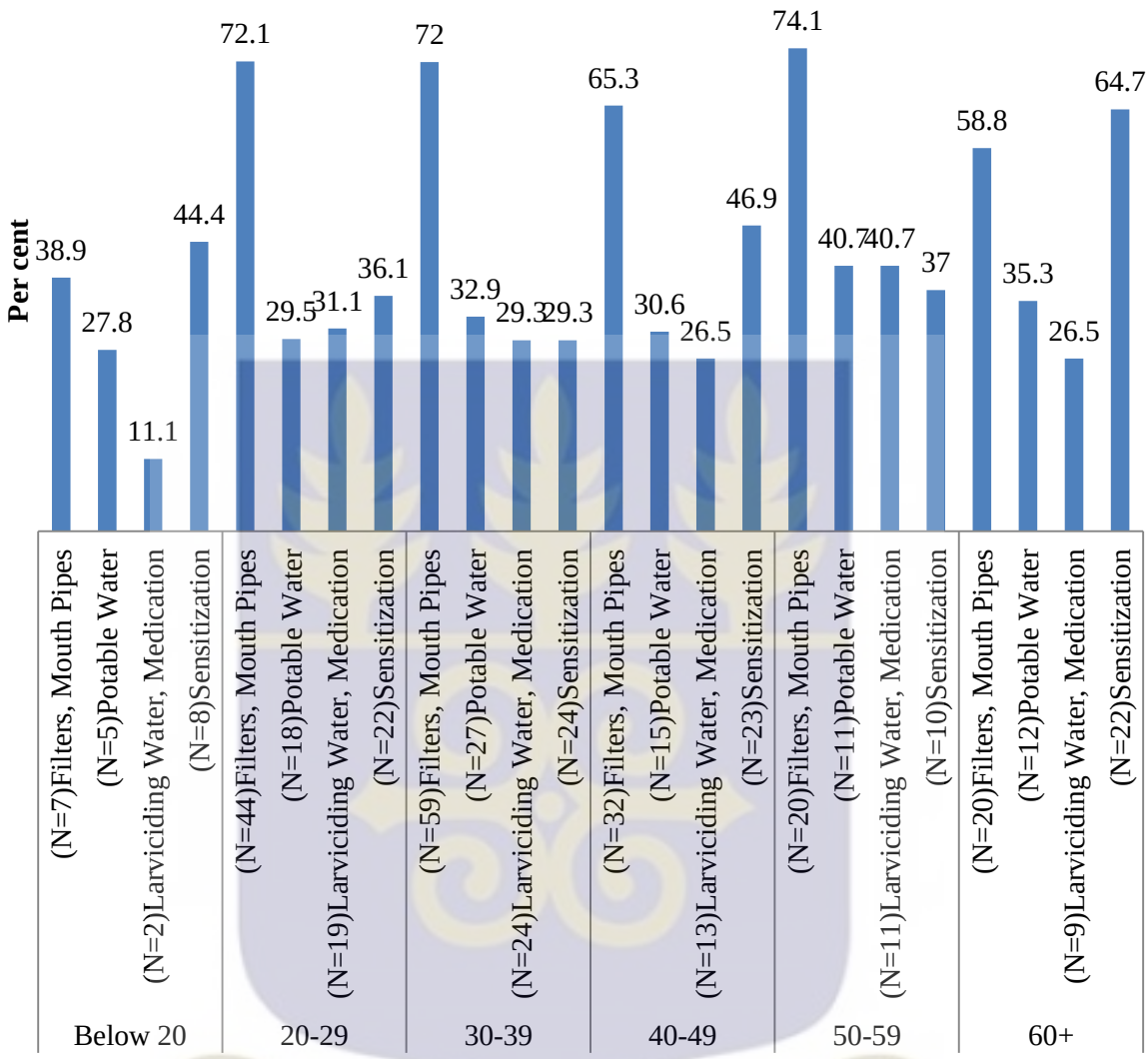
Figure 6.3: Activities of GWEP by respondent category



Source: Field Data, 2012

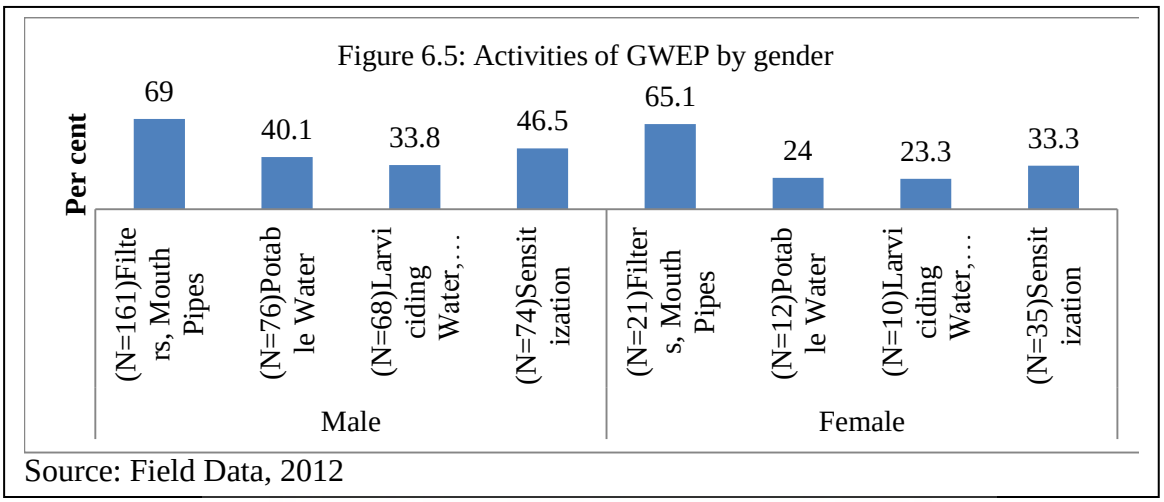
It was found in Figure 6.3 that 67.8% and 57.1% of opinion leaders and household heads and residents indicated the programme carried out its operation by providing filters, mouth pipes, sources of potable water, and education programmes. Almost 43% of house hold heads and residents indicated that the programme carried out its operations by larviciding of surface sources of dinking water, providing medication aimed at extracting the worm, and providing cloth filters. Whereas 33% of opinion leaders indicated the programme provided potable water, household heads and residents did not think the programme provided potable water.

Figure 6.4: Activities of GWEP by age



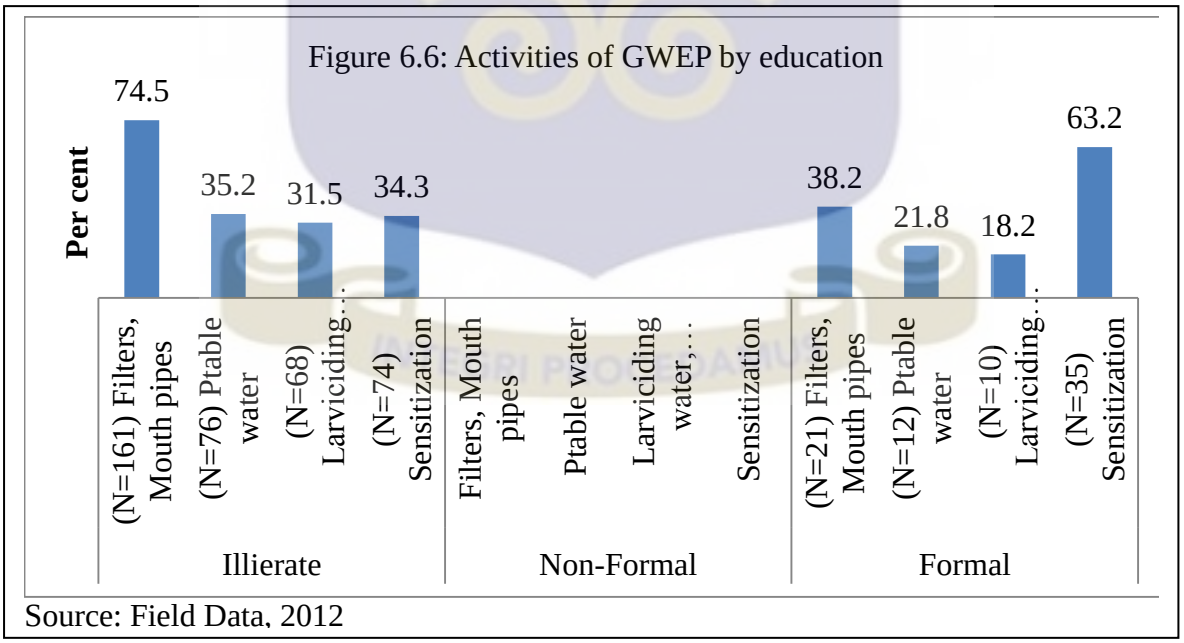
Source: Field Data, 2012

With regard to how the programme carried on its operations by age it was realized in Figure 6.4 that majority respondents (59% and 72%) between the ages of 20 and 60 years indicated that the programme provided cloth filters and educational programmes. This was followed with respondents in all age groups indicating the programme provided potable water and larviciding surface sources of drinking water.



Source: Field Data, 2012

When the activities of the programme were examined by sex, Figure 6.5 revealed that males and females representing 69% and 65.1% respectively indicated the programme carried out its operations by providing cloth filters and mouth pipes. This was followed by 46.5% and 40% males indicating the programme undertook educational programme and provided potable water. The responses of larviciding water sources and providing medical treatment was almost evenly distributed between both sexes.

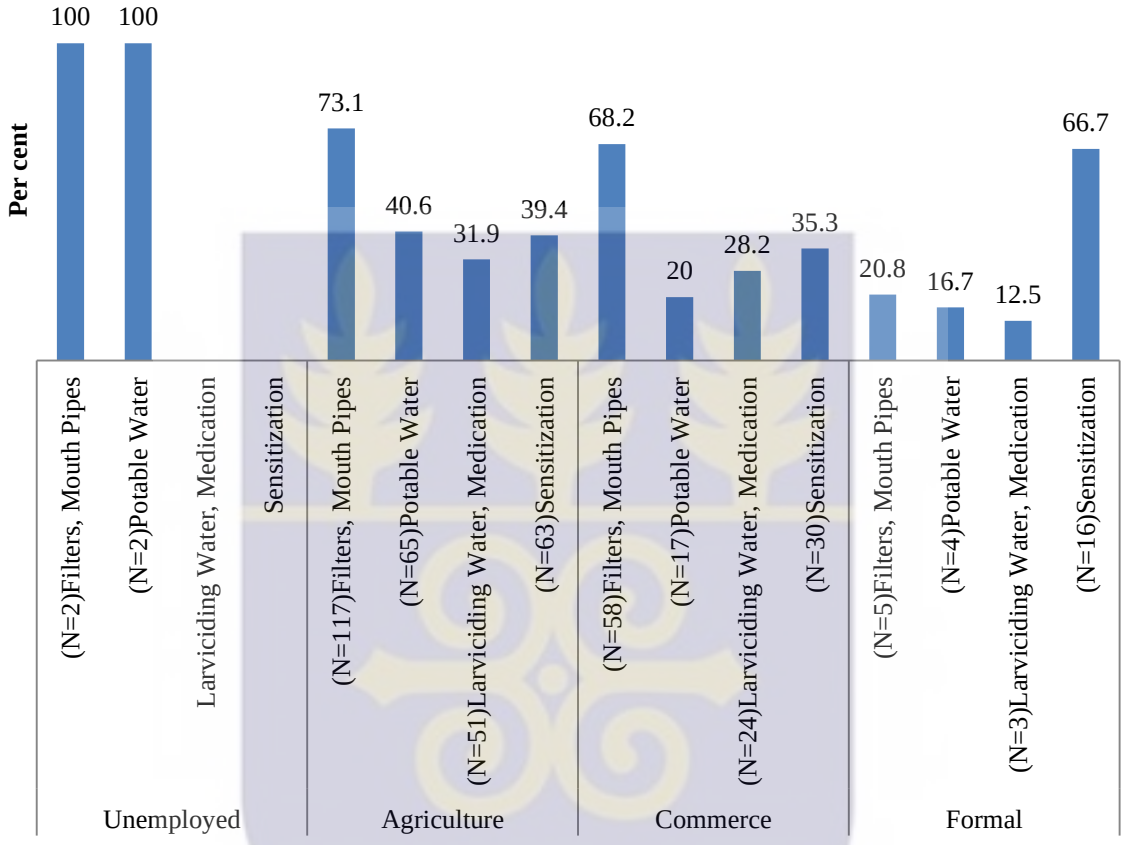


Source: Field Data, 2012

With respect to how the programme carried out its activities by education Figure 6.6 revealed that illiterate respondents had 74.5% indicating the programme carried out it operations by

providing cloth filters, while those with formal education had 63.6% indicating the programme carried out educational programmes on the disease.

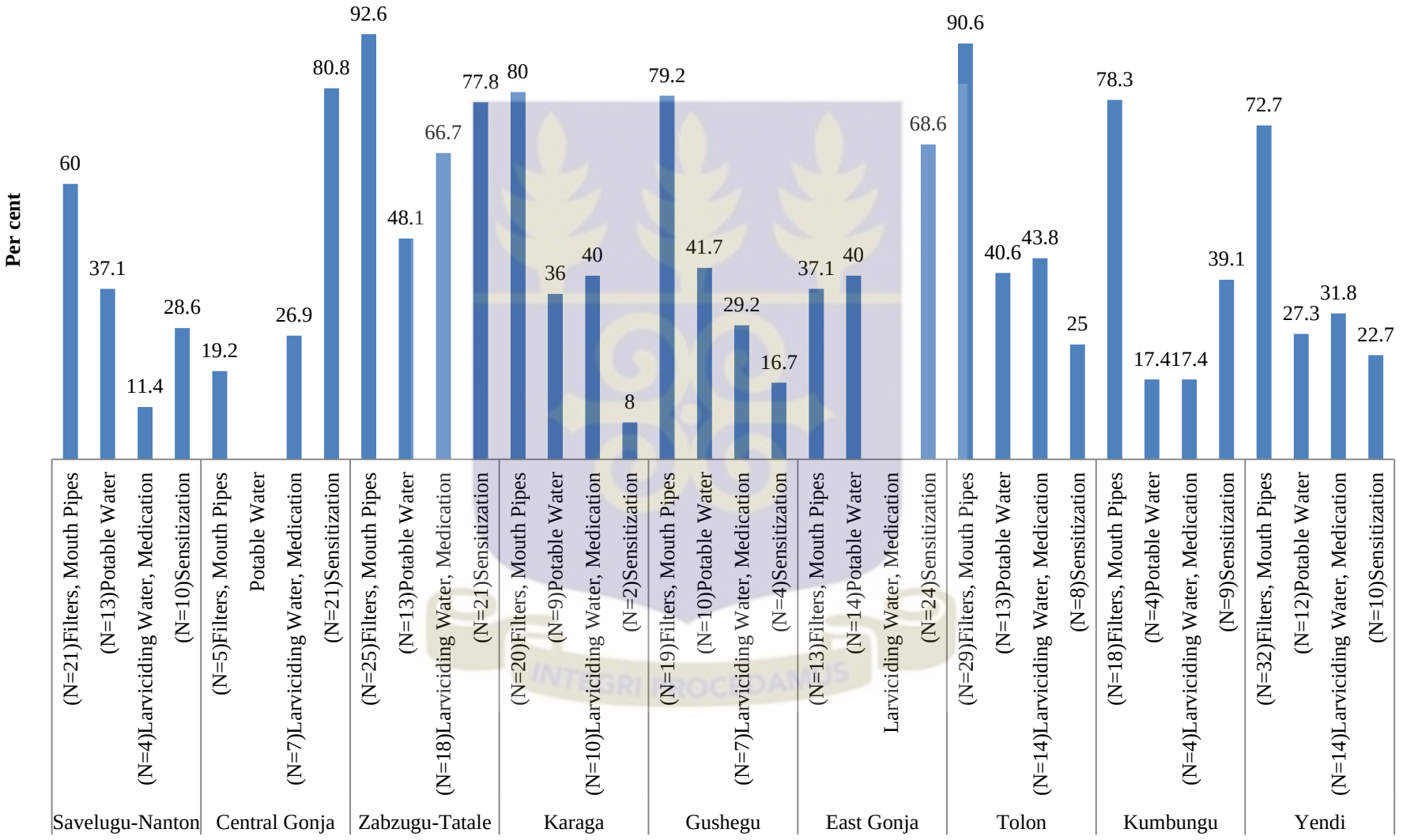
Figure 6.7: Activities of GWEP by occupation



Source: Field Data, 2012

When it came to the operations of the programme by occupation Figure 6.7 revealed the unemployed had all respondents indicating the programme provided potable water and mouth pipes. Respondents in the agricultural and commercial sectors had 73.1% and 68.2% respectively indicating the programme provided their communities with mouth pipes. Respondents in the formal sector had majority of them (66.7%) indicating the programme educated people on how to avoid the disease.

Figure 6.8:Activities of GWEP by district



Source: Field Data, 2012

When operations of the programme were cross tabulated by district it was realized from Figure 6.8 that majority of respondents from Zabzugu-Tatale (92.6%), Tolon (90.6%), Karaga (80%), Gushegu and Kumbungu 79.2% and 78.3% respectively, Yendi (72.2%) and Savelugu-Nanton (60%) indicating the programme carried out its operations by providing mouth pipes. This was followed by respondents from Central Gonja (80.8%), Zabzugu (77.8%), East Gonja (68.6%) indicating the programme's activities came in the form of educating community members on how to avoid the disease. Also, 66.7% of respondents from Zabzugu-Tatale, 43.8% from Tolon, and 31.8% from Yendi district indicated that the programme's activities came in the form of trearing their surface sources of drinking water. In addition, Zabzugu-Tatale, Gushegu, and Tolon had 48%, 42%, and 41% respectively of respondents indicating that the progamme's activities were realized in the provision of potable water.

Table 6.2: Chi-square test on activities of GWEP

Variable	Value	df	Asymp. Sig
Respondent Category	239.207	248	.644
Age	1269.145	1240	.276
Geder	252.424	248	.410
Education	254.206	248	.380
Occupation	789.566	744	.120
District	2114.467	1984	.021

Source: Field Data, 2012

The activities of the programme with respect to respondent category, age, gender, education, occupation, and district were subjected to Pearson's Chi square test to determine which of them are statistically related. At a significance level of 0.05 it was found in Table 6.2 above that, activities of the programme were significantly related to district which had a p-value less than 0.05. This indicates that activities of the programme to eradicate the disease were largely influenced by district.

6.3.1 Management of unsafe sources of drinking water

It was brought to light during the research that one of the primary tasks the programme set for itself was to properly manage unsafe sources of water supply (34.4%), to break the chain of transmission of guinea worm infections in the former guinea worm endemic areas of the Northern Region. The programme achieved this task by adopting two strategies: proper handling of unsafe sources of water supply, and treating unprotected water bodies.

The programme was able to persuade community members to avoid coming into direct contact with unsafe sources of water supply. The programme managed to instill among the people the habit of boiling and filtering their water before using or drinking it. In furtherance of this task the programme procured and distributed cloth filters to members of the former guinea worm endemic areas of the Northern Region of Ghana. A 42 year old teacher respondent recounts the programme's task of getting community members to properly handle unsafe sources of drinking water by noting that:

> "The education that the worm was from [surface sources of] water and the acceptance of that idea by community members led to the filtration of the water before drinking."

Source: Extracts from FGD and Structured Questionnaire, Field Data, 2012

Another respondent's view on the topic went to deepen the earlier expressed opinion on the programme's activities of making community members to pursue safe water handling practices:

> "Obedience of the community to adhere to the fact that they should filter their water before drinking led to reduction in re-infection."

Source: Extracts from FGD and Structured Questionnaire, Field Data, 2012

Through its volunteer village workers the programme made community members avoid coming into direct contact with open water bodies by placing planks along entry points of unprotected water bodies for people to stand on to fetch water.

The other strategy the programme adopted to manage unsafe sources of water supply was the treatment of these sources of water supply with the biodegradable chemical Abate. The application of this chemical was aimed at arresting the further development of the water flea to their infective stages. Munira Abukari expressed her view on the treatment of their unsafe sources of water supply with the biodegradable chemical by saying: "The spraying of chemicals in water has killed the worm."

6.3.2 Inter sectoral collaboration

Another task which respondents indicated the programme adopted to achieve its objective was the inter sectoral collaboration it went into with the PHC delivery system of the GHS (28.2%). This was evidenced in records in which the American Cyanamid Company agreed to donate Abate (Temephos) valued at over 2 million USD to the Carter Centre's Global 2000 GWEP. In making the donation, the executive vice president of the company… noted that "… it is satisfying to know that [their] donation of Abate larvicide will enable men, women, and children to live without fear of the water they drink to survive. And it was part of their effort in helping to ensure that all wells and waterholes in West Africa are treated with Abate (CDC, 1989).

6.3.3 Providing safe sources of water supply

Some 23.2% of respondents indicated that the programme was instrumental in influencing government policy in providing safe sources of water supply to most of the rural communities of the former guinea worm endemic areas of the Northern Region. An interview with an official of the community water and sanitation agency in Tamale indicated that between 1990 and 2006 about six GWEP inspired community water projects were completed in some rural

areas in the Northern Region, including some of the guinea worm endemic areas. Notable among these water projects was the CIDA funded GAP 1 and 2 projects for the Northern, Upper East, and Upper West Regions of Ghana: 1990-2000; the IDA and World Bank Funded "The First Community Water and Sanitation Project" (CWSP) in the Western, Ashanti, Brong Ahafo, and Northern regions (IDA, World Bank): 1994 – 2000; the UNICEF Programme Assisted Phase I and II, Northern and Upper East Regions and Guinea Worm Endemic Communities in Brong Ahafo, Volta and Afram Plains: 2000-2004; the EU funded Rural Water and Sanitation Project in Northern Region: 2000-2006; the CIDA funded Rural Water and Sanitation Project in Northern Region: 2000-2006; the AFD funded rural water and sanitation project in Northern Region 2000-2006; and, the Government of Ghana and HIPC funded Guinea Worm Eradication Project in Volta, Brong Ahafo, Northern, Upper East and Upper West Regions. These locally and externally funded community water projects received sustained government support with the establishment of the Community Water and Sanitation Agency in 1998 "to facilitate the provision of safe water ... to rural communities and small towns" (CWSA ACT 596) (CWSA, Tamale, 2012). The GWEP has, since the inception of the CWSA, collaborated with it to facilitate the provision of potable water to most of the former guinea worm endemic communities in the Northern Region.

6.3.4 Disseminating information on avoiding guinea worm infection

Another 11.8% of respondents indicated that the programme was engaged in disseminating information to people on how to avoid the disease. The programme educated and sensitized the people in the former guinea worm endemic areas of the region to come to terms with the scientific causes of guinea worm infection. People were taught about the causes and the preventive measures of the disease by educating and teaching them to boil, sieve and filter their water before drinking. One of the educational tasks the GWEP pursued was the effort of getting the people in the former guinea worm endemic areas to adopt the practice of avoiding direct contact with surface sources of drinking water. The success of the educational

and sensitization component of the programme was fully captured in the responses of 37 and 42 years old teachers who respectively said:

> "Realising that the worm was from open water bodies, people then followed the steps the programme gave to eradicate it";

Source: Extracts from FGD and Structured Questionnaire, Field Data, 2012

> "The education that the worm was from [surface sources of] water and the acceptance of that idea by the community members led to the filtration of the water before drinking it."

Source: Extracts from FGD and Structured Questionnaire, Field Data, 2012

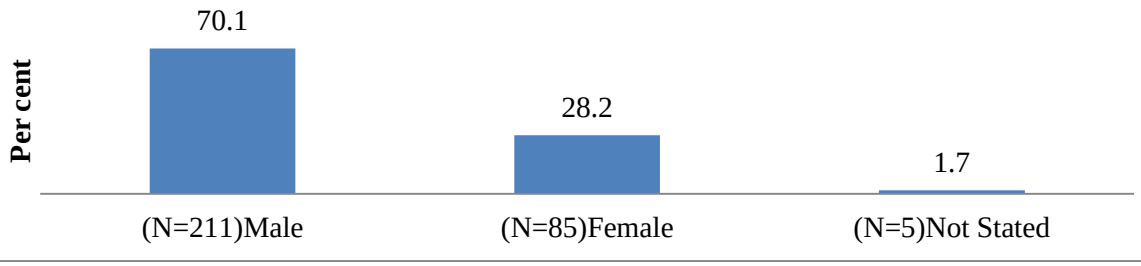
Through the dissemination of information on what the causes of GWD were and how it can be prevented, this group of respondents ascribed the reduction and eventual eradication of the disease to the series of educational and sensitization programmes which the programme gave to the former Guinea Worm Endemic Communities of the Northern Region.

6.4 Factors responsible for the eradication of GWD

The fourth objective of the research was directed at determining the factors that influenced the reduction and eventual eradication of the disease. In this regard the null and alternate hypotheses: H° - increase in the provision of potable water did not cause a significant decrease in the number of cases of guinea worm infections; and, H^{1} - increase in the provision of potable water caused a significant decrease in the number of cases of guinea worm infections, respectively were used to establish the effectiveness of the GWEP in eradicating the disease in the region.

It was found from the population that majority (70%) were male; and 28% were female. Figure 6.9 gives the sex distribution of respondents for the test of the hypotheses in the former guinea worm endemic communities of the Northern Region.

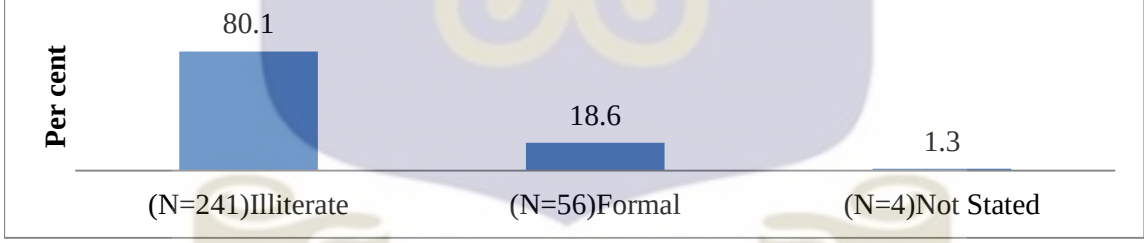
Figure 6.9: Gender distribution of respondents



Source: Field Data, June 2013

With respect to the educational characteristics of respondents it was found that majority (80.1%) of respondents did not have any form of formal education. The rest (19%) either had primary, secondary, or tertiary education. What this meant was that responses from a largely illiterate population may reflect a true and accurate account of respondents' views on the intervention measures which were considered most responsible for the eradication of the disease. Figure 6.10 gives a summary of the educational characteristics of respondents in the former guinea worm endemic districts of the Northern Region.

Figure 6.10: Educational characteristics of respondents



Source: Field Data, June 2013

With regard to the occupational characteristics of respondents it was found some 87.1% were engaged in the agricultural and commercial sectors, while the remaining 13.3% were either engaged in the formal sector or were unemployed. What this meant was that responses from a largely agrarian labour force may reflect a true account of the measures that were considered most responsible for the eradication of the disease. Figure 6.11 gives a summary of the occupational characteristics of respondents for the test of the hypotheses of the research in the former guinea worm endemic districts of the Northern Region.

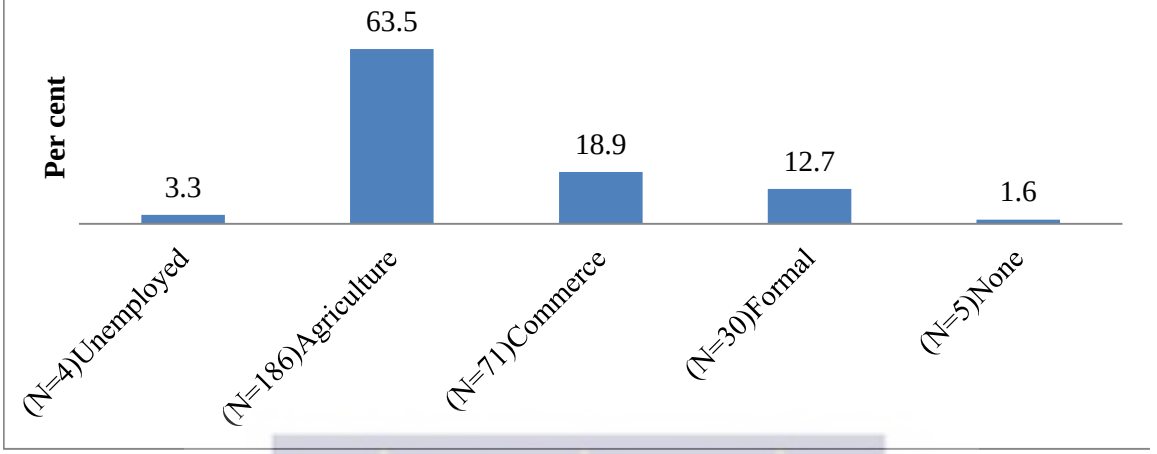


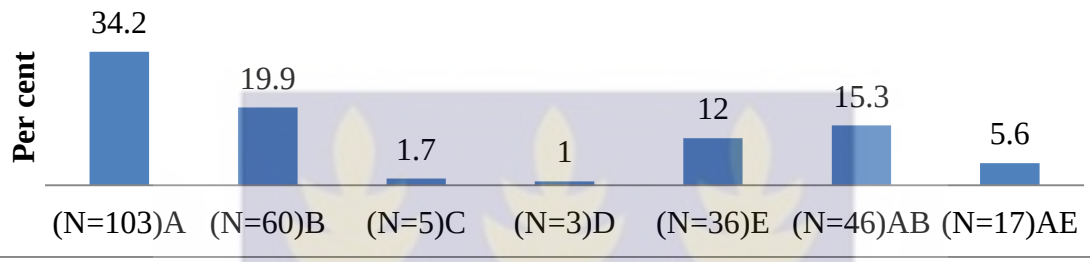
Figure 6.11: Occupational characteristics of respondents

Source: Field Data, June 2013

A simple statistical summary to determine which factors in the opinion of respondents was responsible for the eradication of the disease in the region revealed that intervention measures of the programme (34.2%) and sources of water supply (19.9%) were responsible for the reduction in the number of cases and eventual eradication of the disease. Next was community cooperation with the GWEP (12%), acquired knowledge about the disease (1.7%), and improvements in domestic and community sanitation (1%); 15.3%, and 5.6% of respondents thought intervention measures, sources of water supply and community cooperation with the programme were responsible for the eradication of the disease. Some 4.6% indicated that intervention measures, acquired knowledge on the disease, and improved sanitation were responsible for the eradication of the disease. Another 3.3 % felt intervention measures, improved sanitation, and community cooperation with the programme was responsible for the eradication of the disease. Another 2.6% pointed to sources of water supply, improved sanitation and community cooperation as being responsible for the eradication of the disease. This is shown in Figure 6.12 below. The statistical details in the figure revealed that the factors that were responsible for the eradication of the disease came in the following descending order: very strong, strong, quite strong, and weak. Based on this categorization the factors that featured prominently in the eradication of the disease was

intervention measures. The double combined effect of these factors were considered to have exerted either a strong or a quite strong influence, while the triple combined effect of these factors had a minimal influence in eradicating the disease. Respondents therefore felt the combined effect of the very strong to the quite strong factors were more responsible for the eradication of the disease.

Figure 6.12: Factors responsible for eradication of GWD



KEY
A.....Intervention measures of the GWEP
B.....Sources of water supply
C.....Acquired knowledge on the disease
D.....Improved Sanitation
E.....Community co-operation with the GWEP
Source: Field Data, June 2013

There were residual responses which came in the form of a combination of factors which respondents gave as being responsible for the eradication of the disease in the Northern Region. Respondents in this group ranged between 2.3% and 0.3%. Their responses pointed to the fact that several factors worked together to eradicate the disease. For instance some said it was intervention measures of the programme plus acquired knowledge on the disease that led to the eradication of the disease.

Another category suggested that it was the provision of potable water and acquired knowledge on the disease that caused the disease to be eradicated. There was yet another group who suggested that provision of potable water and community cooperation with the programme contributed to the eradication of the disease. Lastly, there were some respondents who suggested that almost all the factors discussed above were responsible for the eradication

of the disease. For example some mentioned the provision of potable water, acquired knowledge on the disease and community cooperation with the programme for being responsible for the eradication of the disease.

Flowing from the above statistical details the hypotheses of the research was tested using Pearson's Chi-square test. At a 5% significance level to find out which factors given by community members, was more responsible for the reduction in the number of guinea worm cases in the Northern Region, it was found that the test yielded a result that rejected the null hypotheses in favour of the alternate hypotheses, which had a p-value of .000 which was less than 0.05. It was therefore concluded that among the reasons stated for the causes of the reduction in the number of cases of guinea worm infections, intervention measures was considered more responsible for the reduction in the number of cases of guinea worm infections, in the former guinea worm endemic districts of the Northern Region.

With 80% of respondents not having any form of formal education and 81% engaged in rural agriculture and commerce it can be said that the population which is largely illiterate and unurbanized felt the presence of the GWEP and paid attention to the intervention measures that were prescribed by the programme to eradicate the disease. This meant that Guinea Worm Freed Areas benefitted from the medical expertise which the programme provided and cooperated with the programme in its outreach activities.

The work of the CWSA in early 2000 to the mid 2000s also came on board to strengthen the intervention measures of the programme by providing small scale community water supply facilities and boreholes in some of the Guinea Worm Freed Areas of the region, thus

effectively disrupting local survival and transmission and re-transmission of the disease in the agent-host factor relationship of the triangle of disease ecology.

6.5 Temporal analysis of guinea worm eradication in Northern Region

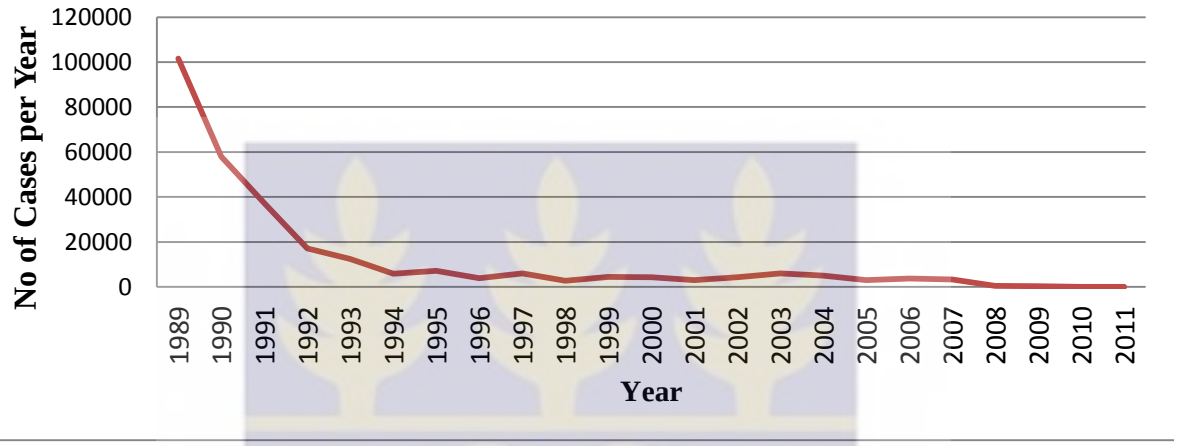
Before the GWEP started, cases of guinea worm infection were casually attended to at community health centres. Between 1982 and 1988 the number of reported cases of guinea worm infection in the guinea worm endemic areas of the Northern Region was 101,524 in approximately 3, 684 villages. The programme started its operations in the region between 1986 and 1988 (Bugri, 1993; CDC, 1987, 1988, 1989).

The programme began active eradication measures in the region in November 1993. Shortly after the programme started its operations an ethnic conflict broke out in the region and rolled back the progress that the programme was beginning to achieve in the region. The guinea worm endemic districts which came under a state of emergency had as much as 75% of the region's recorded cases of guinea worm infections and, 54% of all reported cases of guinea worm infections nationwide (CDC, 1994). With people getting displaced from the guinea worm endemic conflict zones there was the risk of the reintroduction of the disease into places that had began to experience a reduction in the prevalence of guinea worm infections.

Ever since the programme started its operations in the Northern Region in 1989 the region experienced a progressive decline in the number of reported cases of guinea worm infections. During the 7 years period between 1989 and 1995 the number of reported cases of guinea worm infections decreased by 94.2% (CDC, 1995); between 1996 and 2002 the number of reported cases of guinea worm infections increased by 9.5% (CDC, 2003); between 2003 and 2009 the number of reported cases of guinea worm infections decreased by 96%; and between 2010 and 2011 the number of reported cases of guinea worm infections decreased by 100% (CDC, 2011; The Carter Centre, 2010-11). During the programme decreases in the

number of reported cases outstripped reversals in the number of reported cases meaninging that the programme was effective from the time the programme started until the last cases of guinea worm infections were reported. The decreasing and increasing trends of guinea worm infections in the Northern Region are illustrated in Figure 6.13.

Figure 6.13: Trend of guinea worm infections in Northern Region: 1989-2011



Source: National Secretariat, GWEP, Tamale, 2012

A Regional Guinea Worm Eradication Committee was formed and given the task of monitoring eradication activities at the district and zonal levels of guinea worm eradication, and to transmit information on the programme to the National Secretariat of the GWEP in Tamale. The membership of the committee was made up of members from the Regional Health Management team, Regional Officers from the department of mobilization and social welfare, the Ministry of Information, the Ghana Water Company and the Community Water and Sanitation Agency (Dr. S.Z. Bugri, First National Coordinator of GWEP).

The intervention measures for eradicating the disease in the region included community education and sensitization programmes, sieving, filtering and boiling of water, worm extraction, application of Abate larvicide to sources of drinking water on a monthly basis, and firmly holding unto the requirements of case containment. The main objective of health education was to create awareness among the people of guinea worm endemic districts in the

Northern Region so as to equip them with the requisite skills for them to contribute towards achieving the programme's objective of eradicating guinea worm as a disease of public health and socio-economic importance (Dr. S.Z. Bugri, First National Coordinator of GWEP).

In its attempt to free the region from the disease the programme made rapid progress between 1989 and 1994 to reduce the number of reported cases of guinea worm infections by 95672 or 94.2%. During the early years of the programme (1989-90) appreciable progress was made when the number of reported cases of guinea worm infections was reduced by 42.9% and 20.4% for the 1989-90 and 1990-91 health periods respectively. Between 1991 and 1992 the number of reported cases of guinea worm infections was further reduced by another 19.7%. The trend in the reduction in the number of reported cases continued up to 1994 with the number of reported cases being reduced by 12371 and 5852 during the 1992-93 and 1993-94 health periods respectively. The uninterrupted significant reductions in the number of reported cases of guinea worm infections in Ghana between 1989 and 1994 respectively seemed to suggest that the GWEP was set to achieve its objective of eradicating the disease in the Northern Region by the end of 1995 (CDC, 1989 – 1995).

However, as a result of ethnic conflict in 1994 and 2002 the programme experienced a series of setbacks between the 1994-95 and the 2005-06 health periods, as a result of registering fluctuating increases and decreases in the number of reported cases of guinea worm infections (CDC, 1994, 2006). The GWEP experienced its first setback in the 1994-95 health period when the programme recorded an increase in the number of cases of guinea worm infections over the previous year, which was the 1993-94 health period. The number of reported cases for the 1994-95 health period was 7116 cases which represented an 80% increase in the number of reported cases over the previous year. This reversal of progress in

achieving the goal of the programme of eradicating the disease in the region by the end of 1995 during the 1994-95 health period suggested that the programme was to realize its objective of eradicating the disease in the region at a later date.

The programme managed to correct the setback of increased reported cases of guinea worm infections in the 1994-95 health period by reducing the number of reported cases of guinea worm infections by approximately 3% in the 1995-96 health period. The progress that was made in the 1995-96 health period was reversed in the 1996-97 health period when the number of reported cases of guinea worm infections was increased by 2%. In the 1998-99 health period the number of reported cases of guinea worm infections increased to 4386, thereby increasing the number of reported cases of guinea worm infections by some 1.7%. During the 1999-2000 and the 2000-01 health periods the number of reported cases of guinea worm infections reduced by 0.1% and 1.4% respectively; but these gains were slightly eroded and deepened further in the 2001-02 and 2002-03 health periods when the number of reported cases of guinea worm infections was increased by 1.3% and 1.7% respectively. The disease was, however, able to inflict a slight injury to the programme's effort at eradicating the disease during the 2005-06 health period by registering a 0.7% increase in the number of reported cases of guinea worm infections. It was, however, after the setback of the 2005-06 health period of the programme's campaign against the disease that the programme was able to maintain a sustained reduction in the number of reported cases of guinea worm infections and, progressively reduced the number of reported cases of guinea worm infections to zero towards the middle of the 2010-11 health period.

The health periods after the 2005-06 health periods were the 2006-07, 2007-08, 2008-09, 2009-10 and the 2010-11 health periods when the number of reported cases of guinea worm

infections reduced by 0.4%, 2.7%, 0.2%, 0.2%, and 0% respectively. The success of the 2008-09 and the 2009-10 health periods, when the number of reported cases of guinea worm infections reduced drastically from 23714 cases to 8 cases (GHS/GWEP, 2012; The Carter Centre, 2010, 2011), indicated that the programme's campaign against the disease in the region was coming to a successful end.

There were reports of people who were believed to have transported the disease in to other communities. When the prevalence of the disease began registering phenomenal reductions in the guinea worm endemic districts of the region there were instances in which reported cases of guinea worm infections were imported into the former guinea worm endemic districts of the region. It was conjectured that some of these cases came from other parts of the region, where prevalence levels were so low that they either went unnoticed or made their appearance in some of the former guinea worm endemic communities in the Northern Region. A particular case in point was the situation of Tamale Municipality harbouring some cases of guinea worm infections; but because Tamale is a cross cultural centre it was not certain if those cases were contracted in Tamale Municipal Area or were imported into the area, and were subsequently exported to the former guinea worm endemic communities in the Region (Dr. S.Z. Bugri, First National Coordinator of GWEP).

GWEP recorded zero cases of guinea worm infections in the 2010-11 health period; this record of the programme during the 2010-11health period set the stage for the programme to begin the end of the programme's operations in the region. The analyses of the guinea worm epidemic in the Northern Region from 1989 to the middle of 2010 are shown in Plate 4 and Table 6.3. It was therefore realized from Table 6.3 and Figure 6.14 that the effective

eradication of the disease from the region begun in 2001 and ended in June 2010, when no case was recorded (GHS, 2010).

These findings were set against the concepts of the Ivorian and Uzbekistan situations to determine at what stage during the implementation of the programme did they influence the phenomenal decrease in the number of reported cases of guinea worm infections. It was observed that the apparent slow progress in the reduction of the number of reported cases between 1989 and 2000 was caused by the Uzbekistan situation because majority of the rural areas of the guinea worm endemic districts in the region relied more on eradication measures than having access to pipe borne water. The rapid progress in the reduction in the number of reported cases of guinea worm infections between 2001 and 2010 was largely influenced by the circumstances of the Ivorian situation because this period witnessed an expansion in the spatial coverage in the provision of piped water supply (Plate 5 below and Plate 6 on page 163) by the CWSA in the guinea worm endemic districts of the Northern Region.

Plate 5: Eradication measures: Larviciding surface sources of drinking water

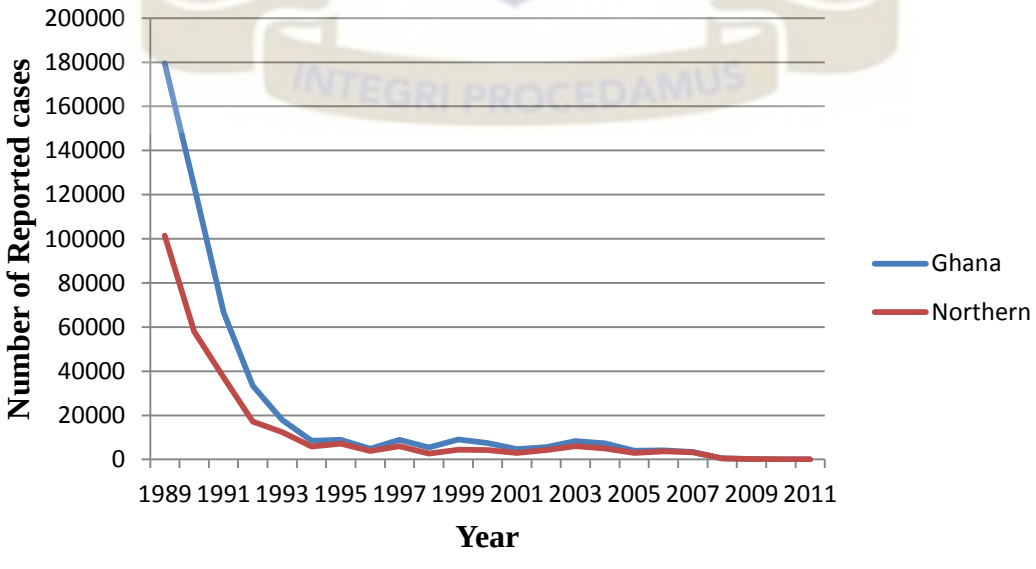
Source: Courtsey who.int; mcc.gov/images/Ghana,Northern region, Water and Sanitation

Table 6.3: Percentage changes of guinea worm prevalence in Northern Region: 1989 – 2011

Year	Health period	Per cent change per health period		
		No of Reported cases	Per cent	Per centage change
1989	1989	101524	100	-
1990	1989-90	57934	57.06	42.94
1991	1990-91	37181	36.62	20.44
1992	1991-92	17140	16.88	19.74
1993	1992-93	12371	12.19	4.70
1994	1993-94	5852	5.76	6.42
1995	1994-95	7116	7.01	-1.25
1996	1995-96	3902	3.84	3.17
1997	1996-97	5989	5.90	-2.06
1998	1997-98	2705	2.66	3.24
1999	1998-99	4386	4.32	-1.66
2000	1999-00	4317	4.25	0.07
2001	2000-01	2929	2.89	1.37
2002	2001-02	4273	4.21	-1.32
2003	2002-03	5999	5.91	-1.70
2004	2003-04	4979	4.90	1.01
2005	2004-05	2981	2.94	1.97
2006	2005-06	3679	3.62	-0.69
2007	2006-07	3237	3.19	0.44
2008	2007-08	479	0.47	2.72
2009	2008-09	237	0.23	0.24
2010	2009-10	8	0.01	0.22
2011	2010-11	0	0	0

Source: GWEP, Tamale from Community Water and Sanitation Agency, February, 2012

Figure 6.14: Decreases in cases of guinea worm infections in Northern Region: 1989-2011



Source: GHS/GWEP, 2012

6.6 Influence of water systems on endemicity after implementation of GWEP

As part of the fourth objective and third proposition of the research, the research took on the task of carrying out an analysis of water systems that influenced the eradication of GWD in the Northern Region, and how the operations of the GWEP influenced the introduction of improved innovations in the provision of water systems for the people in the guinea worm endemic areas of the region. To achieve this objective and proposition the research defined social development and innovations to be the different sources of water supply which people in the study area rely on for their drinking water.

An attempt was therefore made to show the probable relationship between the provision of drinking water in the former guinea worm endemic areas in the Northern Region and the reduction and eventual eradication of the disease in the region. The period that was reviewed was after 1989; the year the GWEP was established. In this regard, the 2000 and 2010 population and housing census reports for the Northern Region and the 2012 cumulative records of the GWEP and the GHS were relied on for the examination.

The water systems that were considered to have a probable effect on the reduction and eventual eradication of the disease in the region were the provision of piped sources of drinking water. The sources of drinking water according to the population and housing censuses were broadly put into the following categories: pipe borne; borehole; well; and, surface water, i.e. dams, ponds, dugouts, canals, lakes and rivers. For the purpose of the analysis these categories were later classified into two major sources of drinking water: potable water, which includes pipe borne, bore hole, well, and rain harvesting; and, surface sources or water from open water bodies, which includes dams, ponds, dugouts, rivers, canals, and lakes. The periods that were used to analyse the role of water systems on the prevalence of cases of guinea worm infections in the Northern Region were the years 2000

and 2010. The water system that was examined for the purposes of the research was restricted to the sources of water supply which the people in the region rely on for their drinking water. In the year 2000 the Northern Region had ten administrative districts, which doubled to twenty in 2010 (GSS, 2000, 2010). Table 6.4 shows the districts that existed in the Northern Region of Ghana between 2000 and 2010.

During the periods when these administrative districts (2000 and 2010) were created there were difficulties about the boundaries of these districts. These new creations presented problems when it came to making comparisons between districts that existed during the pre-guinea worm eradication period and the period the programme was in active operation. Another difficulty that was encountered during the analysis was the fact that the districts which were classified as guinea worm endemic areas kept changing. This resulted in some places which were once guinea worm endemic areas falling out of the group of districts that were once considered guinea worm endemic districts. This was observed in the Nanumba area and part of Gonja where places like Kpandai which lie further south of the region becoming administrative districts and was thus no longer classified as guinea worm endemic areas. What this suggested was that even though some administrative districts were broadly classified as guinea worm endemic areas there were areas in these districts which were not affected by the disease; and so were exempt from the epidemic. When these areas attained district status they automatically became non-guinea worm endemic areas.

Table 6.4: Administrative districts in Northern Region: 2000 and 2010

YEAR		YEAR	
2000		2010	
DISTRICT	POPULATION	DISTRICT	POPULATION
Tamale Metropolis	293881	Tamale Metropolis	371351
Yendi	130506	Yendi	199592
Gushiegu-Karaga	125430	Gushiegu	111259
Tolon-Kumbungu	122550	Karaga	77706
Savelugu-Nanton	808059	Tolon- Kumbungu	112331
Zabzugu-Tatale	77496	Savelugu-Nanton	139283
Saboba-Chereponi	93100	Zabzugu-Tatale	123854
Nanumba North	144277	Saboba	65706
Bole	126532	Chereponi	53394
East Gonja	174500	Bole	61593
West Gonja	139260	East Gonja	135450
East Mamprusi	174824	West Gonja	84727
West Mamprusi	115015	Central Gonja	87877
Sawla-Tuna-Kalba	"	Sawla-Tuna-Kalba	99863
Central Gonja	"	Nanumba North	141584
Chereponi	"	Nanumba South	93464
Karaga	"	Kpandai	108816
Kpandai	"	East Mamprusi	121009
Nanumba South	"	West Mamprusi	168011
Bunkpurugu-Yonyo	"	Bunkpurugu-Yonyo	122591

Source: GSS: 2000 Population and Housing Census; 2010 Population and Housing Census

In 1989 the Northern Region had as many as 101, 524 reported cases of guinea worm infections. By the year 2000 the number of cases of guinea worm infections in the region decreased by 95.8% to register a prevalence rate of 4.3%. Between 2000 and 2010 the number of reported cases of guinea worm infections in the Northern Region reduced further by 99.9% to an all-time prevalence rate of 0.1% (GHS, 2012; CDC, 2000; The Carter Centre, 2009-10). These impressive decreases in the prevalence rate in the number of reported cases of guinea worm infections in the Northern Region was considered sufficient grounds to examine the region's water supply facilities in relation to the progressive reductions in the prevalence rate of the disease in the Region. The landmark events which were considered for examination were the 2000 and 2010 population and housing censuses that were held in the

country, and the Northern Region being the only region in the country in 2010 that recorded 8 cases of guinea worm infections (GHS, 2010; CDC, 2010). A sign that the fight against the guinea worm epidemic in Ghana was drawing to a successful end. The question that arose from these observations was, apart from the intervention measures the programme adopted to reduce the prevalence and eventual eradication of the disease in Ghana, and the Northern Region in particular, could the presence or absence of certain water supply facilities be said to have contributed towards reducing and eventually eradicating the disease in the Northern Region in particular?

To answer this question an attempt was made to find out the extent to which districts and especially the former guinea worm endemic districts in the Northern Region had access to either potable water or surface sources of drinking water, which was considered an unsafe source of water supply.

6.6.1 Types of drinking water in Northern Region and guinea worm endemic area of the region: 2000 and 2010

The social infrastructure that have a meaningful connection with the presence or absence of GWD is the provision of potable water. The availability of potable water as against reliance on surface sources of water supply between 2000 and 2010 was examined to determine whether sources of drinking water during this period played an important role in influencing the eradication of the disease in the Guinea Worm Freed Areas of the Northern Region (GSS, 2000, 2010).

In the year 2000 the Tamale Metropolitan Area and the East Mamprusi district had the highest access to potable water with 84.9% and 81% respectively of these areas having access to potable water. These administrative areas, however, relied less on surface sources of drinking water with the Tamale Metropolis relying on 15% and the East Mamprusi district

relying on 19.8% of surface sources of drinking water. The Yendi and Bole districts followed next in rank to the Tamale Metropolis and the East Mamprusi district. These administrative areas had 67.7% and 66% respectively of their areas having access to potable water. In comparison to the Tamale Metropolis and the East Mamprusi district, the Yendi area represented by 32% and the Bole area represented by 34% respectively relied more on surface sources of drinking water. The West Mamprusi and Zabzugu-Tatale districts came third in rank with 53.8% and 51.7% respectively in having access to potable water. It was found that their dependence on unprotected sources of water supply was quite high as the West Mamprusi and Zabzugu-Tatale districts had 46% and 48.4% respectively of their areas relying on unprotected sources of water supply for the rest of their drinking water (GSS, 2000).

Even though the Nanumba district ranked fourth in providing 42.7% of the area with potable water, it was also found to rely more on unprotected sources of drinking water as 57.3% of the district relied more on unprotected sources of drinking water. From this point forward the rest of the districts in the Northern Region was found from the analysis to have less access to potable sources of water supply and relied more on unprotected sources of drinking water (GSS, 2000). In furtherance of this point it was found that whereas 37% of the Gushiegu district and 37% of the Saboba-Chereponi district had access to potable water, 62.8% and 63% respectively of these districts relied on unprotected sources of water supply for their drinking water. The Tolon-Kumbungu, East Gonja, West Gonja, and Savelugu-Nanton districts each had 31%, 30%, 29.5%, and 29.4% respectively of their areas being served with potable sources of drinking water. These areas were, however, outstripped by their unprotected sources of drinking water as Tolon-Kumbungu, East Gonja, West Gonja, and

Savelugu-Nanton had as much as 69%, 70%, 70.5%, and 70.6% respectively of these districts relying on unprotected sources of water supply (GSS, 2000).

It was, however, realized from the foregone analysis that by the year 2000 the Northern Region depended more on unprotected sources of drinking water than potable sources as the former had as much as 54% of the districts in the region relying on unprotected sources of water supply as against 46% relying on potable sources of water supply, representing an 8% increase in favour of unprotected sources of water supply. With regard to the sources of drinking water for the former guinea worm endemic districts of the Northern Region for the year 2000 it was observed that the Yendi and Zabzugu-Tatale districts had a high reliance on potable sources of water for their drinking water as they relied on 68% and 52% respectively on potable sources of water, and relied least on unprotected sources of drinking water with Zabzugu-Tatale and Yendi districts obtaining 48.4% and 32% respectively of their drinking water from unprotected sources of drinking water (GSS, 2000). The other former guinea worm endemic districts, namely Savelugu-Nanton, West Gonja, East Gonja, Tolon, Gushiegu, Nanumba, and Zabzugu-Tatale by the year 2000 continued to rely more on surface sources of water supply than potable sources, as 57.3% to 70.6% of these districts relied on unprotected sources of drinking water while 29% to 42.7% relied on potable sources of water supply. Based on the forgone analysis it was realized that by the year 2000 most of the former guinea worm endemic areas in the Northern Region of Ghana were still heavily dependent on unprotected sources of drinking water as 75% of the former guinea worm endemic districts were found to rely more on unprotected sources of water supply for their drinking water (GSS, 2000).

From the foregone analysis it was not possible to establish a relationship between the phenomenal decrease in the number of reported cases of guinea worm infections by 95.75% to achieve a prevalence rate of 4.3% and sources of drinking water between 1989 and 2000, as 75% of the former guinea worm endemic areas continued to rely more on unprotected sources of water supply, with the remaining 25% relying more on potable sources of drinking water (GSS, 2000; GHS/GWEP, 2012).

In 2010 the Tamale Metropolitan Area was again found to be the administrative district that had the greatest access to potable water (17%) and the lowest reliance on unprotected sources of water supply (2%). The Yendi district came second with 5% access to potable water with a relatively high reliance on unprotected sources of water supply (2%) as compared with the Tamale Metropolis. The following districts: West Mamprusi, Nanumba North, Sawla-Tuna-Kalba, Savelugu-Nanton, Zabzugu-Tatale, were classified third in having access to potable water as they each had 4%, 3.5%, 3.4%, 3.1%, and 3.1% access respectively to potable water. With the exception of the West Mamprusi district which still had a high reliance on unprotected sources of drinking water (2.3%) as compared to its potable sources, the other districts relied less on unprotected sources of water supply with an average reliance of 1.4% (GSS, 2010).

The districts that were classified fourth in having access to potable water were the Bunkpurugu-Yunyoo, Bole, Kpandai, West Gonja, East Mamprusi, East Gonja, Gushiegu, and Nanumba South with an average access of 3% to potable water. Despite this relative high average for this group of districts, it was found upon careful examination that the East Gonja district still continued to rely more on surface sources of water supply than potable sources as some 3.4% of the district was dependent on unprotected sources of water supply.

Bunkpurugu-Yunyoo and Kpandai were slightly below the potable average access of 2.5% reliance on unprotected sources of drinking water. The East Mamprusi, Nanumba South, and Gushiegu districts were found to rely less on unprotected sources of water supply as they had an average reliance of 1.5% on open water bodies as compared to the potable average access of 2.6%. The West Gonja and Bole districts had the lowest reliance on unprotected sources of water supply with an average reliance of approximately 1%. From the foregoing it can be concluded that these districts relied slightly more on potable source than unprotected sources of water supply (GSS, 2010). The districts which came fifth in the classification of having access to potable water were the Tolon, Saboba, Karaga, Chereponi and Central Gonja with an average access of 1% in these areas. It was found out that the Tolon and Central Gonja districts relied more on unprotected sources of water supply with some 2.4% of their areas relying on unprotected sources of water supply as compared to the average potable access of 1%. However, Saboba, Chereponi, and Karaga were found to rely more on potable sources of water supply because these districts were found to have an average reliance of 1.2% on unprotected sources of water supply which is below the average potable access of 1% (GSS, 2010).

With regard to the sources of drinking water for the former guinea worm endemic districts in the Northern Region of Ghana for the year 2010 it was observed that the former guinea worm endemic districts of Yendi and Nanumba North further improved upon their reliance on potable sources of drinking water. The former guinea worm endemic district of Savelugu-Nanton which relied least on potable water in 2000 raised its reliance on potable water to rank third with the Zabzugu-Tatale district after the Nanumba North district in 2010. The Zabzugu-Tatale district, during this period registered a low reliance on unprotected sources of water supply. The East Gonja district seemed to have a good reliance on potable sources of

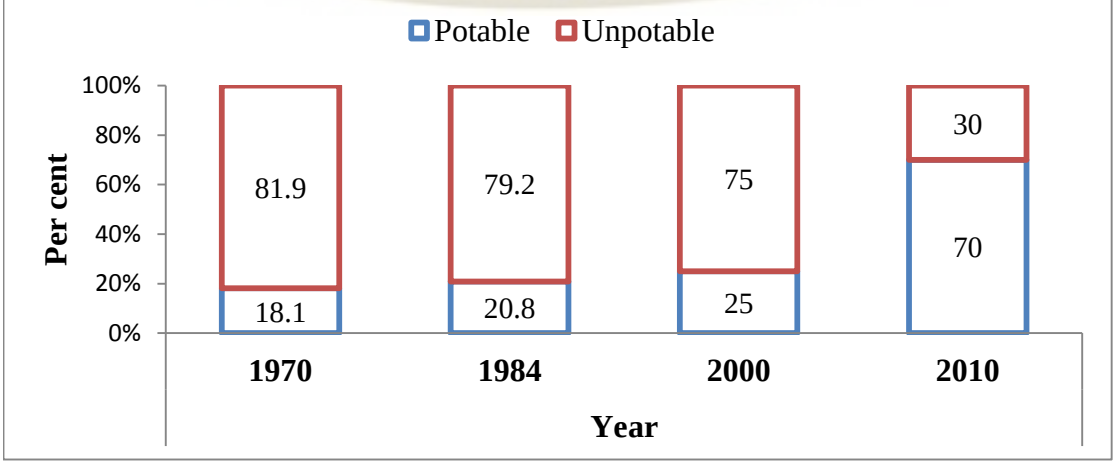
water supply in 2010; but the district was found to be the district in the region that relied most on unprotected sources of water supply for it drinking water needs. The former guinea worm endemic district of Gushiegu was found to have an almost balanced reliance on potable and unprotected sources of drinking water (GSS, 2000, 2010).

In 2010 the former guinea worm endemic district of Nanumba South relied slightly more on unprotected sources of water supply, while the former guinea worm endemic district of Tolon relied less on potable water (1.8%) and slightly more on surface sources of drinking water (2%). The former guinea worm endemic districts of Karaga and Central Gonja were found in 2010 to have recorded the lowest access to potable sources of water supply; with both having approximately 1% each. In contrast Central Gonja was found to be the second highest among the former guinea worm endemic districts in the Northern Region to rely on unprotected sources of water supply (2.6%). Karaga, however, had a lower reliance on unprotected sources of water supply as it had about 1.2% of the district relying on unprotected sources of water supply (GSS, 2010). By the year 2010 it was observed that the former guinea worm endemic districts in the Northern Region relied more on potable sources (61.7%) of water supply than unprotected sources (38.2%) of drinking water. During this period, 70% of the former guinea worm endemic districts in the Northern Region were found to rely more on potable sources of drinking water. It was only the East Gonja, Central Gonja, and Tolon districts that continued to rely more on unprotected sources of drinking water than potable sources (GSS, 2010).

Between 2000 and 2010 the number of reported cases of guinea worm infections reduced by 99.9% suggesting that the 75% shift from unprotected sources of drinking water in 2000 to a 70% reliance on potable sources of drinking water in 2010 contributed to the decrease in the

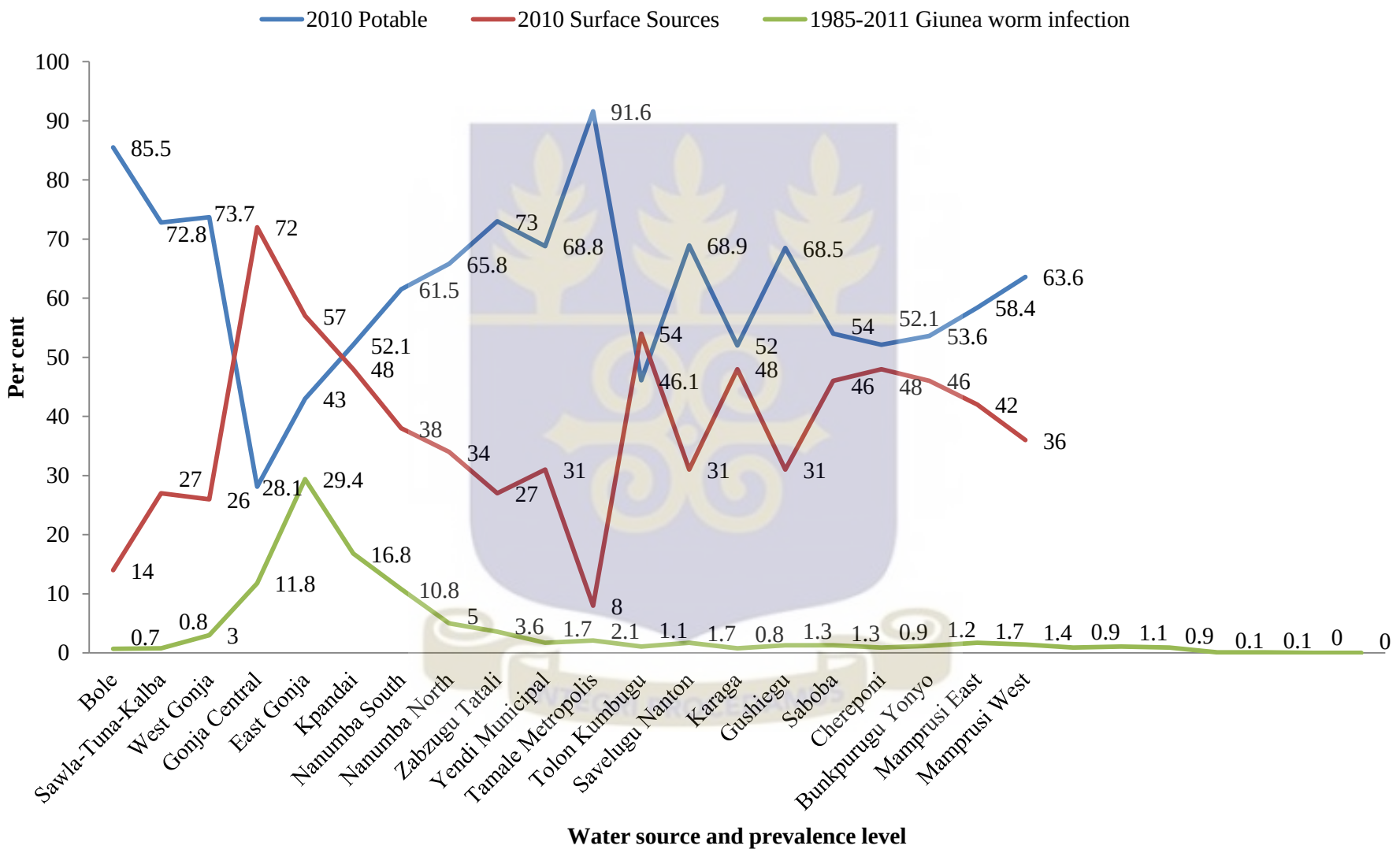
prevalence of guinea worm infections to 0.1%. Two of these infections came from the Savelugu-Nanton district, with one each coming from the Karaga and East Gonja districts, with no reported cases of guinea worm infections for the rest of Ghana. Figures 6.15 and 6.16, shows the progression of water supply facilities in the Northern Region of Ghana by district between 1970 and 2010 which contributed towards the eradication of the disease in the former guinea worm endemic districts in the region (GHS, 2012; GSS, 2010). It was observed that the sources of water supply that accounted for the disease in the former guinea worm endemic areas of the region was the inadequate provision of potable water and the extensive reliance on surface sources of water supply between 1970 and 1984. There was no meaningful shift from reliance on surface sources of water supply to the provision of potable water during the 2000 programme period (GSS, 1970, 1984, 2000, 2010). However, during the 2010 programme period, the Northern Region recorded a meaningful shift from the reliance on surface sources of water supply to the provision of potable water, with final cases of guinea worm infections being recorded in the region in 2011 (The Carter Center, 2011, GHS/GWEP, 2012). The increased reliance on potable water in 2010 can be said to have positively contributed towards eliminating re-infections of guinea worm in the region.

Figure 6.15: Dependence on Potable and Surface Sources of Drinking Water in Northern Region: 1970-2010



Source: Ghana Statistical Service, 1970, 1984, 2000, 2010

Figure 6.16: Types of drinking water influencing prevalence levels of GWD in Northern Region by District:2010



Source: Ghana Statistical Service, 2010 Population and Housing Census Summary Report;

Plate 6: CWSA (Community Water and Sanitation Agency) assisted community pipe water systems in the Northern Region, Ghana

Source: Field Data, April 2015

6.7 Problems of the GWEP in Northern Region

Since every human endeavor usually encounters difficulties the research tried to find out some of the problems the programme encountered in the Northern Region. The key informants who gave information on the subject were Dr. S.Z. Bugri (First National GWEP Coordinator, and Chairman of the National Guinea Worm Certification Committee) and Mr. David Agyemang (National Data Manager of GWEP in Tamale). The first difficulty which came up for discussion was that donor agencies, especially Global 2000 provided the programme with logistical support in terms of transportation facilities: pickup trucks, motorbikes, and bicycles. Unfortunately, however, some people in order to benefit from the facilities that were provided for the programme offered themselves as volunteers of the programme at the zonal and village levels of intervention. The purpose for which bicycles for instance were provided was in some instances not put to the use for which they were provided. This left other volunteers who may have been more committed to meeting the objective of the programme without means of transport to ensure "on time reporting" of cases to make the case containment strategy of the programme in the region more effective.

Secondly, there was the complaint of vehicles, especially motorbikes experiencing frequent breakdowns. This was attributed to the poor maintenance culture of officers who were assigned these machines. Some of the assigned officers to these vehicles identified the problem of frequent break downs to the fact that the expertise for maintaining motorbikes at the zonal and village levels of intervention was very poor.

Thirdly, allied to the problem of logistical difficulties was the challenge of accessibility. The condition of roads into the interior of guinea worm endemic villages in the region was in a deplorable state. Additionally, the spatial dimension of separation between most communities was great. The poor condition of roads coupled with communities being far removed from

each other increased the travel time they had to use between villages of endemicity to their zonal centres. Some endemic villages, which had paths and bush tracks for their lines of communication, were sometimes cut off from their zonal centres during peak periods of guinea worm infections.

Fourthly, the supply of Abate and filters to guinea worm endemic districts in the region was found to be highly inadequate given the fact that the region was the most affected region in the country. The result of the highly inadequate supply of equipment deprived some villages of these provisions which were a vital component for eradicating the disease. The inadequate supply of these goods to some endemic villages posed a danger to surface sources of drinking water getting re-infected with the cyclops of the guinea worm.

Fifth, some volunteers had a casual attitude towards the epidemic and the programme. They continued to treat cases of guinea worm infection as one of the ordinary diseases that befell people in the village. Some volunteers did not discharge their duties with a sense of urgency. There were occasional reports of filter cloths not being distributed on time and, surveillance records and reporting at the village level was sometimes poorly done. This situation was however attributed to lack of adequate remuneration and incentives to sustain the enthusiasm of volunteers.

Some beneficiaries of the programme demonstrated low interest in the activities of the programme. There were reports to the effect that some people found it a waste of time to adhere strictly to the intervention measures of the programme. A common offence by some beneficiaries was the lack of initiative on their part to boil their drinking water before preserving it.

Another problem which programme staff found embarrassing was poor attendance to health education gatherings where knowledge on eradication measures was imparted. It was observed that the vulnerable groups were those who turned a blind eye to such gatherings. The purpose of health education to eradicate the disease was sometimes defeated. Respondents for their part cited poor timing as the reason for attendance at health education gatherings not to be encouraging, and the fact that the proliferation of the mass media in their local languages offered them other avenues to acquire knowledge on how to go about avoiding the risk of getting infected with guinea worm.

Finally, sometimes poor communication between the programme and its affiliate government agencies, for example the Ghana Water Company Limited. In providing potable water at the district level the Ghana Water Company Limited did not necessarily direct its attention to villages which were prone to guinea worm infection. This led to the neglect of some guinea worm prone areas which were in dire need of the provision of potable water. The programme overcame this challenge by having greater collaboration with the Community Water and Sanitation Agency.

6.8 Status of GWEP after twenty two years of operations

The operations of the GWEP, as shown in Plate 7, over the past twenty two years show undeniable proof of the programme's success in Ghana. The situation of people getting infected by guinea worm has come close to be considered a thing of the past. GWD has for a long time ceased to be cited as one of the reasons for children being absent from school. Continuous larviciding of surface sources of drinking water with Abate and case containment, contributed in breaking the chain of transmission between surface sources of drinking water and the human host. Fortunately for people there were no cases of permanent disability resulting from the disease.

Plate 7: GWEP related activities: provision of potable water, community education, case containment against guinea worm, filtering drinking water, and providing mouthpipes

Source: Courtesy Cartercentre.org/health/guinea_worm/images; google.com.gh/images;

CHAPTER SEVEN

IMPACT OF THE GUINEA WORM ERADICATION PROGRAMME ON HEALTH AND SOCIO-ECONOMIC DEVELOPMENT IN THE NORTHERN REGION

7.1 Introduction

After examining the operations of the GWEP in Ghana and established the factors that were responsible for the eradication of the disease in the Northern Region this chapter examined the fourth objective and third proposition which is to "determine the effects of the GWEP on health and socio-economic development and the effect the programme has had on people's behaviour towards their environment." The proposition states that "the operations of the GWEP has influenced the introduction of improved innovations in the health and socio-economic development of the people of the Guinea Worm Freed Areas and changed people's behaviour towards the disease". This chapter discussed health, economic and social benefits which the programme may have contributed to the people of the study area.

7.2 Contribution of the GWEP to the health of people

The overall health status and condition of health of the people of guinea worm endemic areas were found to include the realization of: a healthier population; permanent cure to GWD; decrease in frequency of illness; availability of potable water; improved sanitation; and, adoption of good health practices, including the practice of personal hygiene and the use of toilet facilities which were previously considered a luxury. However, there were instances in which it was felt the programme had a retrograde effect on the condition of health of the people of the Guinea Worm Freed Areas of the Northern Region. These effects are discussed in detail in the succeeding sections of this part of the research.

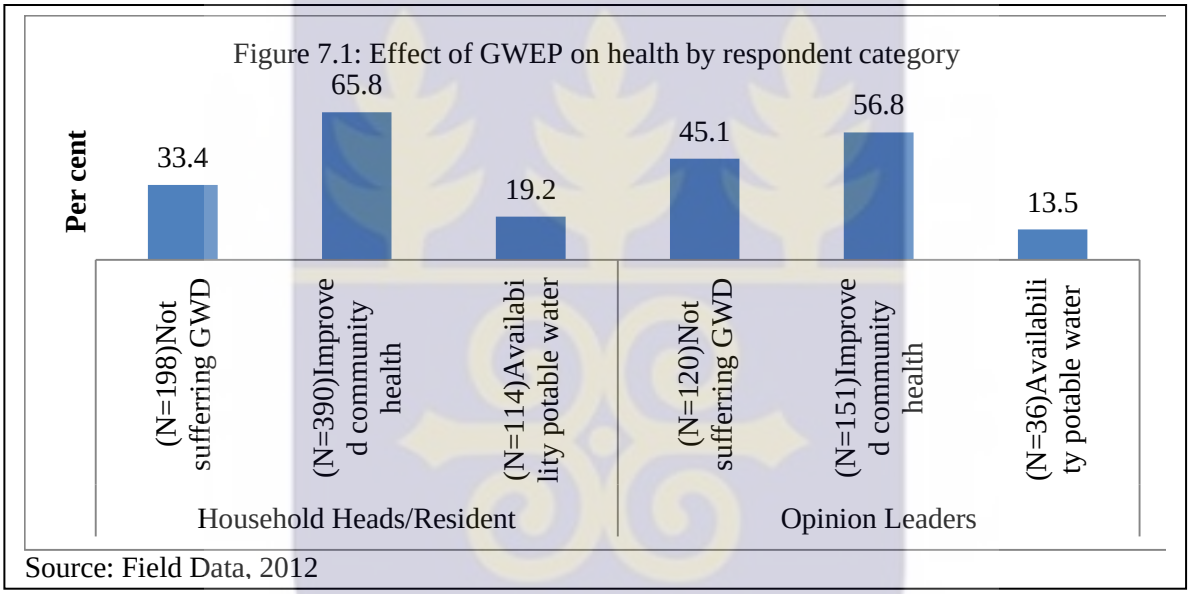
7.2.1 The role of the GWEP in improving the health status of the people in the guinea worm endemic areas of the Northern Region

It was found that there was the general agreement among respondents that the programme had impacted positively on their health status. On the question of if respondents thought the

programme has improved the condition of health of the people all respondents (100%) said the programme had improved their condition of health.

When respondents were asked to indicate how the programme contributed in improving their condition of health, they indicated their condition of health improved because they no longer suffer from the disease, community health status has improved and, they now have access to potable water.

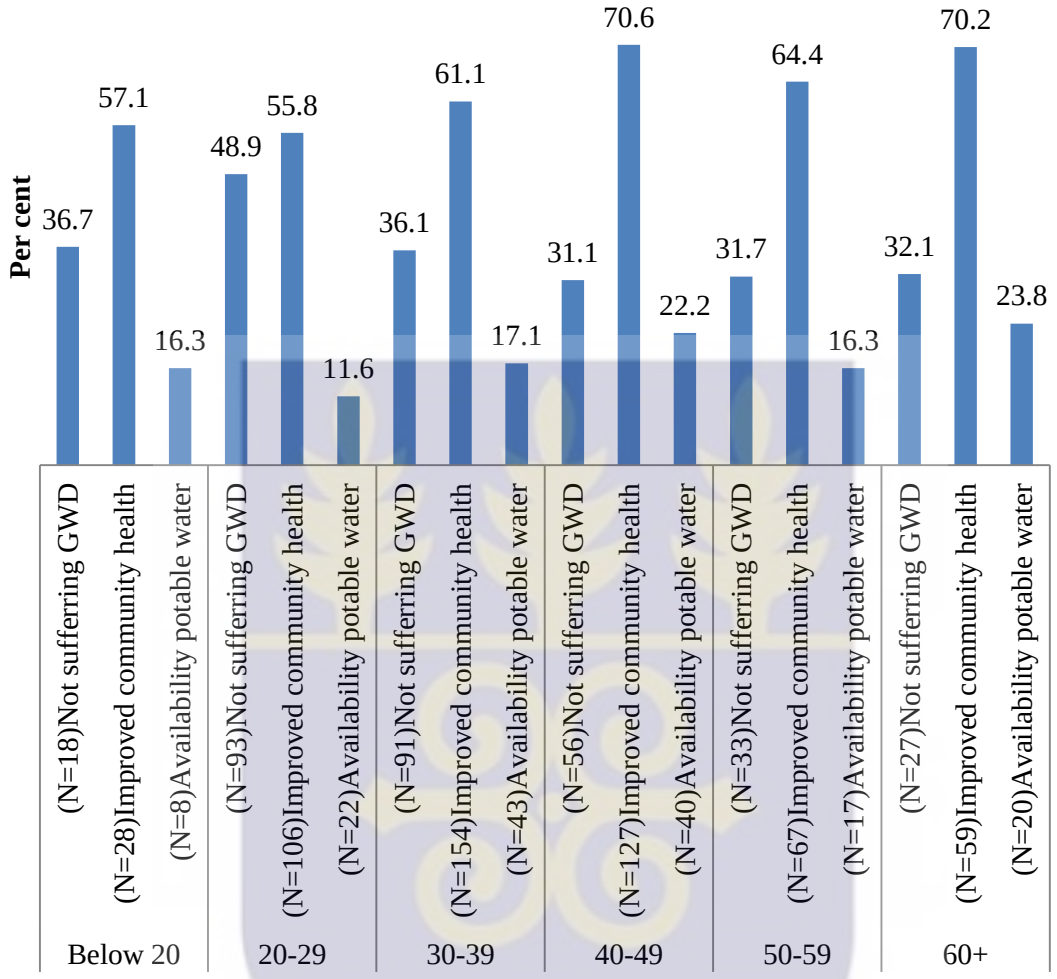
Figure 7.1: Effect of GWEP on health by respondent category



Source: Field Data, 2012

With regard to the ways the programme has contributed to health by respondent category, Figure 7.1 showed that most household heads and residents (65.8%) and opinion leaders (56.8%) indicated that the programme has improved community health status. Most opinion leaders (45%) and household heads/residents (33.4%) indicated that people are not suffering from the disease. Lastly, 19% and 14% of residents and opinion leaders respectively indicated the programme has improved health by making potable water available.

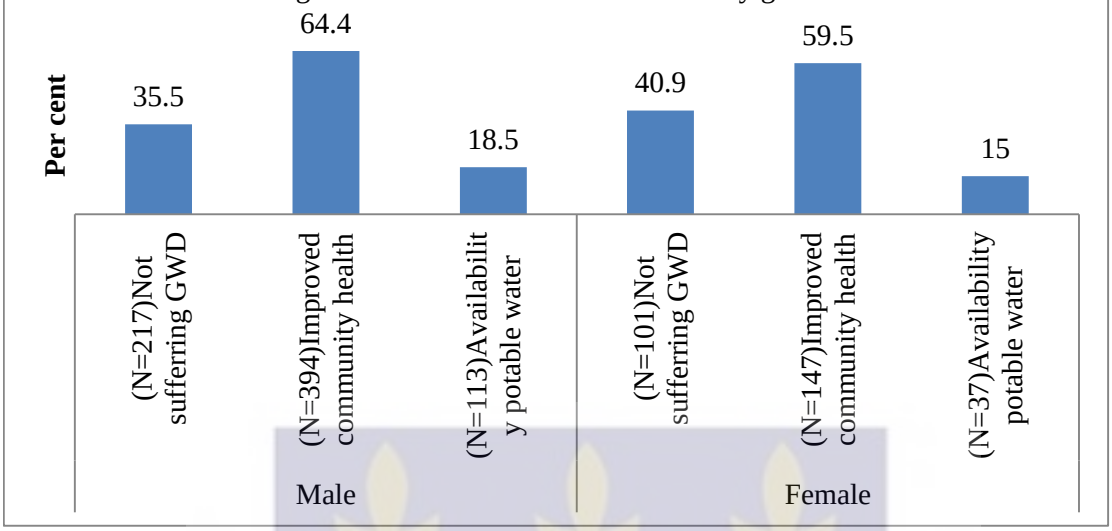
Figure 7.2: Effect of GWEP on health by age



Source: Field Data, 2012

With regard to how the programme improved people's health by age, Figure 7.2 indicated that most respondents from the following age groups: 40-49, 60 and above, 50-59, 30-39, below 20 and 20-29 indicated that the programme has improved community health status. This was followed by those in the 20-29 and below 20 years, 30-39 years and between 40 and 60 and above with approximately 31% for each of these age groups indicating people are no more suffering from the disease. The remaining responses which did not exceed 24% for each age group indicated the programme improved health by making potable water available.

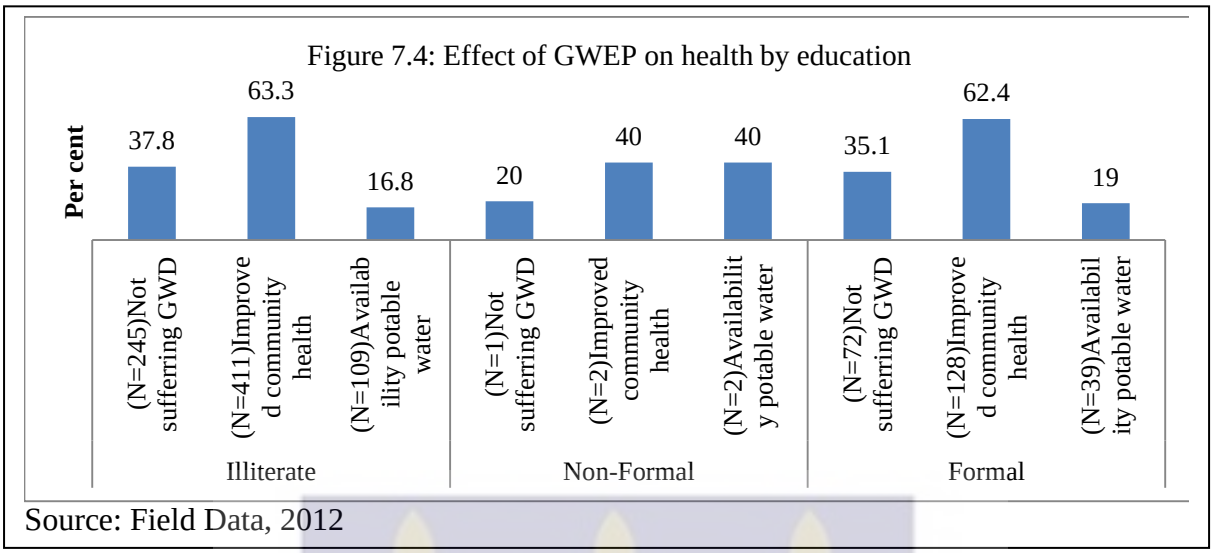
Figure 7.3: Effect of GWEP on health by gender



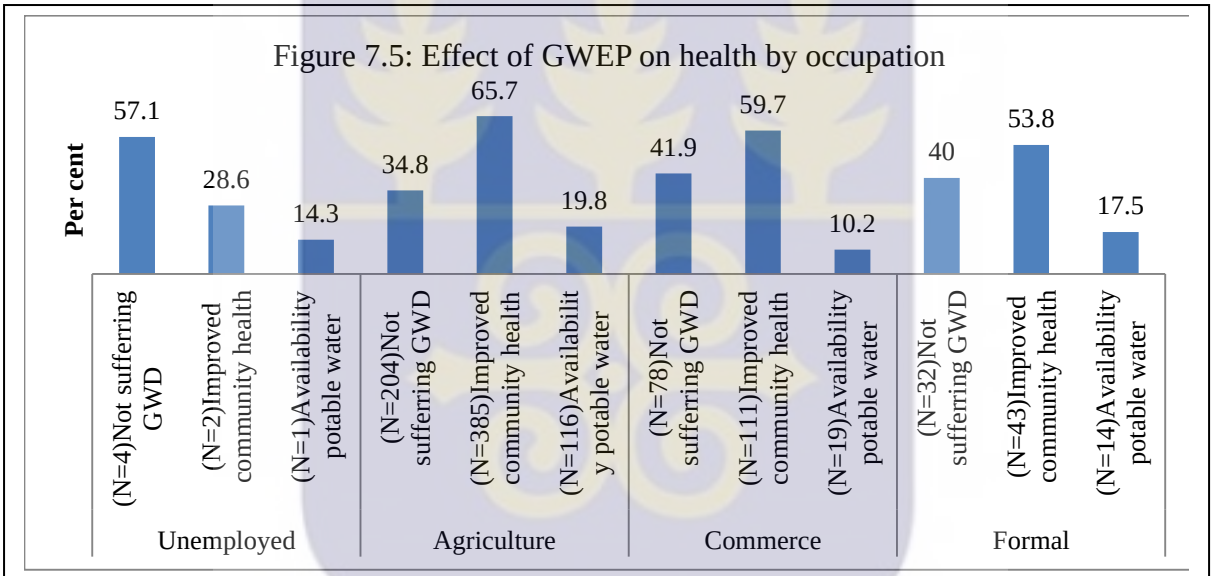
Source: Field Data, 2012

When it came to the effect of the programme on health by sex, Figure 7.3 had most males and females indicating the programme's effect on health came in the form of an improvement in community health. A sizeable number of females and males indicated the programme's effect on health was realized through people not suffering from GWD. Both sexes with below 20% each of respondents indicated health has improved because they have access to potable water.

With respect to the programme's effect on health by education, Figure 7.4 revealed that majority of illiterate respondents and those with formal education were of the opinion the programme has improved community health. In addition, 38% and 35% illiterate and formally educated respondents respectively indicated people are no more suffering from GWD. Respondents with non-formal education were of the opinion the programme's effect on health came in the form of improved community health and availability of potable water. The rest which were between 20% and approximately 17% from all categories indicated the programme's effect on health was people are no more suffering from GWD or now have access to potable water.



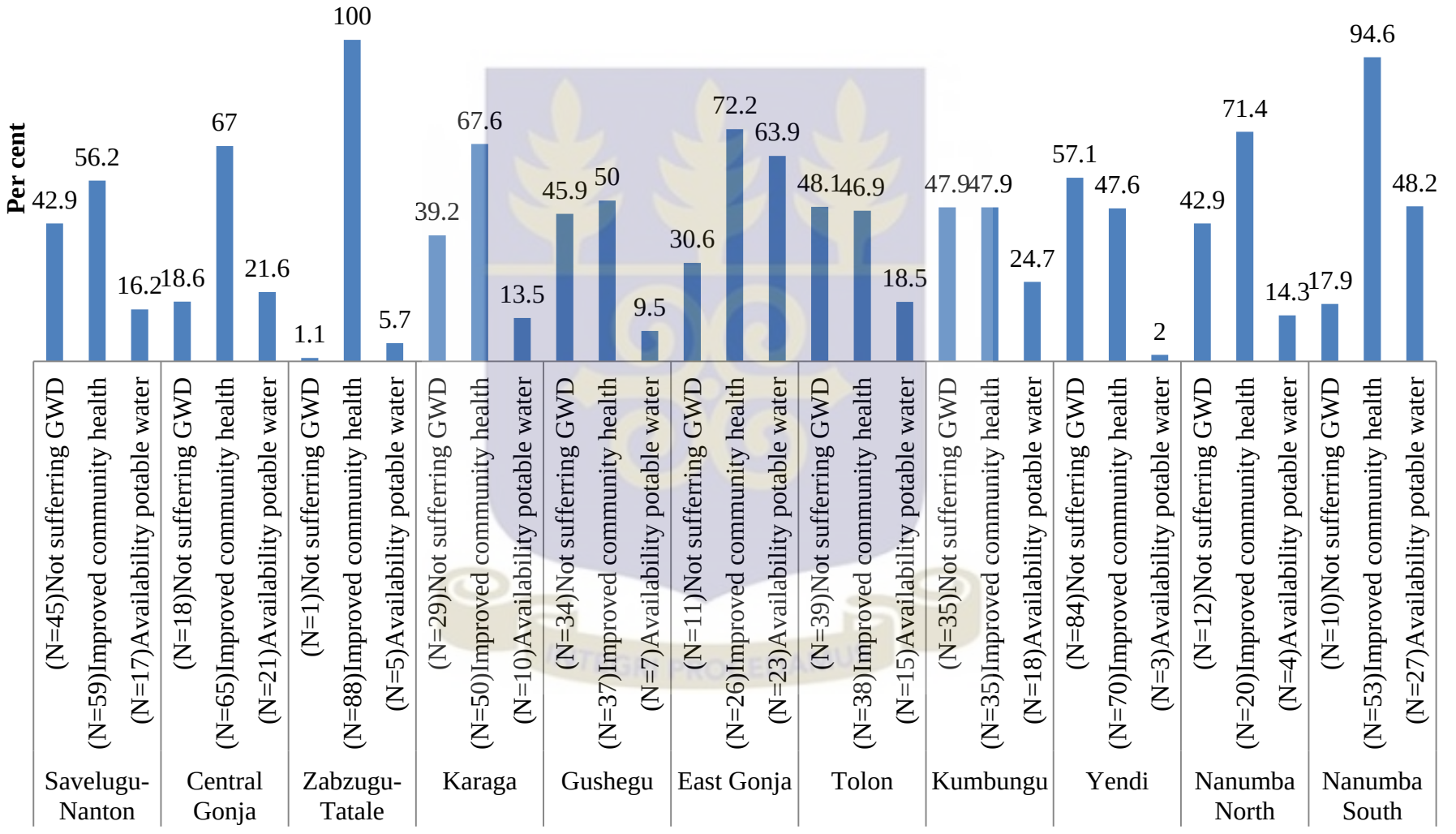
Source: Field Data, 2012



Source: Field Data, 2012

With regard to the effect of the programme on health by occupation, Figure 7.5 showed that 66%, 60%, and 54% of respondents from the agricultural, commercial, and formal sectors respectively indicated that the programme's effect on health was realized in the form of improved community health. This followed by 57%, 42%, 40%, and 35% of the unemployed, commercial, agricultural and formal sectors respectively indicating that people are no more suffering from the disease. Finally, respondents in all occupational sectors and the unemployed with an average of 16% between themselves indicated the programme's effect on health was realized in the form of potable water being available to people.

Figure 7.6: Effect of GWEP on health by district



Source: Field Data, 2012

With respect to the effect of the programme on health by district it was realized from Figure 7.6 that respondents were generally of the opinion that the programme has improved community health status with respondents from Zabzugu-Tatale (100%), Nanumba South (94.6%), East Gonja (72.2%), Nanumba North (71.4%), Karaga (68%), Central Gonja (67%), Savelugu-Namton (56.2%), and Gushegu (50) subscribing to this view. Also, a sizeable number of respondents from East Gonja (64%), Nanumba North (48%), Kumbungu (25%), and Central Gonja (22%) indicated the effect of the programme on health has been realized in the availability of potable water. Finally 57% of respondents from Yendi, 48% each from Kumbungu and Tolon, 46% from Gushiegu, 43% each from Savelugu-Nanton and Nanumba North, 39% from Karaga and approximately 31% from East Gonja indicated that people in affected areas are no more suffering from the disease. The remaing respondents who were mostly below 25% for each district indicated the programme's effect on health was realized in the availability of water.

When the effect of the programme on heath was examined by ethnic group those who agreed to the fact that the programme had contributed towards improving their health status were from the former Dagomba endemic areas, with 65.3% of respondents agreeing to the notion that the programme had improved upon their health status. The former guinea worm endemic areas of Nanumba, Gonja, and Konkomba also attested to the fact that the programme had impacted positively on their health status, with each area recording 13.2%, 11.2%, and 10.4% respectively of respondents holding the view that the programme has improved their health status. During focus group discussions in the Dagomba Guinea Worm Freed Area of Gushiegu it emerged that the disease has become a thing of the past; and that the programme taught people to practice safe water purification methods and to observe personal hygiene. As a result of succeeding in getting communities of the Guinea Worm Freed Areas in the region

to observe personal hygiene most communities experienced a general improvement in sanitation in their individual houses and the entire community. Some contributors also added that the programme resulted in reducing the incidence of malaria in their communities. This could be interpreted to mean that people in the Guinea Worm Freed Areas of the Northern Region became more conscious, during the period of the programme and after, of malaria, and took positive steps to avoid malaria in their communities. In the view of some contributors during Focus Group Discussions there is a general sense of well being in their communities because the immobilizing effect of the disease in their communities has been removed. Table 7.1 is an illustration of respondents' opinions on whether or not the GWEP has improved upon their health.

Table 7.1: Effect of GWEP on health by ethnic group

Traditional Area	Yes	No	Percent
Nanumba	112	-	13.2
Konkomba	88	-	10.4
Gonja	95	-	11.2
Dagomba	555	-	65.3
Total	850		100

Source: Field Data, September 2012 – January 2013

Table 7.2: Chi-square test on effect of GWEP on health

Variable	Value	df	Asymp. Sig
Respondent Category	813.754	795	.314
Age	3976.767	3975	.489
Gender	794.702	795	.496
Education	1514.236	1590	.912
Occupation	2368.364	2385	.592
District	8325.913	7950	.002

Source: Field Data, 2012

The effect of the GWEP on health with respect to respondent category, age, sex, education, occupation, and district were subjected to Pearson's Chi square test to determine which of them are statistically related with respect to improving the health of the people. At a

significance level of 0.05 it was found in Table 7.2 that the effect of the programme on health was significantly related to district. This indicated that effect of the programme on health was statistically related only to district.

7.3 Health benefits of the GWEP

It was discovered that regular treatment of surface sources of drinking water with Abate greatly reduced the chances of community members coming in contact with the cyclops of the guinea worm, and contributed to the drastic reduction in the number of reported cases of guinea worm infections over the years. In hyper endemic areas where cases of guinea worm infections affected approximately 10% of the population, the eradication of the disease was considered a prerequisite to health promotion (The Carter Center, 1999-2000, 2000-2001).

It was generally accepted that the programme as an economic development promoter, indirectly had a strong influence in promoting the health standards of the people in the former guinea worm endemic communities in the Northern Region. The creation of primary health care centres and especially case containment centres in some communities gave people within a certain catchment area access to health care and medicines which was unavailable to them before the programme was launched. Improvements in community productivity and incomes have made it possible for people to afford essential drugs from these centres (The Carter Center, 1998-1999).

7.3.1 A healthier population

According to the survey 27.9% of respondents pointed to the fact that these areas now have a healthier population than before because its effects on every day life has been removed (The Carter Center, 1998-2000, 2000-2001). In the opinion of respondents everybody now moves about freely, and has a sound sleep at night. Able bodied men and women are now healthy to engage in farm work, fetch water and harvest fire wood. The eating habit of everybody has improved because the difficulties associated with the fear of having to go to toilet have

become a thing of the past. The following reports from the former Dagomba endemic area aptly described the improved health status of the people. As one put it: "I am very fit and can farm; health has improved."

Zenabu Timothy, a farmer and trader, also had this to say on the improved health status of people living in the guinea worm endemic areas of the Northern Region:

> "I would have been very slim like an AIDS patient; but I am healthy and can therefore move about."
>
> Source: Extracts from FGD and Structured Questionnaire, Field Data, 2012

7.3.2 Permanent cure to GWD

The second reason why health status has improved is that it has brought a permanent cure for the disease (16.2%) because by mid-2011 Ghana completed 12 consecutive months of zero cases (The Carter Center, 2010-2011). Respondents went further to describe the permanency of the cure to the disease by arguing that it is not possible to find people infected with guinea worm again:

> "Now you can be up to 20 people in a group and nobody is infected" and
> "Now we are full and complete human beings; we don't have cripples again; during that period every gathering was about guinea worm; but now it is not."
>
> Source: Extracts from FGD and Structured Questionnaire, Field Data, 2012

The words of 40 year old Hassan Wumbe were used to conclude the views of respondents when he said:

> "It is beyond description. It is more than 10 years now and I have not experienced guinea worm again."
>
> Source: Extracts from FGD and Structured Questionnaire, Field Data, 2012

7.3.3 Decrease in frequency of illness

The third reason that accounted for respondents holding the view that the GWEP has positively improved the health status of the people in the guinea worm endemic areas was that the programme played a positive role by reducing the rate at which people fell ill (11.8%) by promoting guinea worm awareness weeks, constructing new case containment centres, and rotating guinea worm prevention messages (The Carter Center 2005-2006). It is now observed that there are few diseases among community members. A synergy of responses from the former Gonja endemic areas suggested that the disease was eradicated alongside the reduction of its related diseases. Through the eradication initiative other health improvement issues were taught to the people and this contributed in reducing the frequency at which people fell ill. It was also included in this category of arguments that not only has the rate at which people fall ill reduced, but also the amount of time and money spent on health services has reduced drastically.

7.3.4 Potable water

The fourth contribution of the programme to the development of health was the role it played in influencing government and other agencies to provide the former guinea worm endemic communities in the region with potable water (11.8%) (The Carter Center, 2000-2001, 2007-2008). A respondent from the Konkomba area talked about the improvement of their drinking water situation by saying "[we] have stopped drinking untreated water." Potable water was provided through the drilling of bore holes, the construction of small community pipe systems, small town pipe systems, limited mechanized schemes and rain harvest systems, by the Community Water and Sanitation Agency (CWSA, 2010). The programme also educated community members on how to handle their surface sources of drinking water. The contribution of the programme in improving the health status of former guinea worm endemic districts through the provision of potable water were convincingly expressed by

Mohammed Imoro of Savelugu-Nanton and a respondent from Tolon when they respectively indicated that:

> "There is now pipe water; so clean water is available to use" and
> "We have mechanized boreholes which relieved us from drinking dam water which reduced the number of people who got the disease."
>
> Source: Extracts from FGD and Structured Questionnaire, Field Data, 2012

7.3.5 Improved sanitation

Another 10.3% of respondents were of the opinion that the programme contributed towards improving their health status by educating and helping them to adopt good sanitation practices (CDC, 1987). A response worth reporting in this regard came from the Dagomba area of Tolon:

> "Through the provision and ensuring of proper sanitary practices people were no longer affected by the guinea worm and other diseases."
>
> Source: Extracts from FGD and Structured Questionnaire, Field Data, 2012

7.3.6 Eradication measures and good health practices

Some 14.7% of respondents argued that the GWEP improved the health status of communities in the guinea worm endemic areas through the programme's eradication measures (7.4%) and awareness creation on the adoption of good health practices (7.4%) (The Carter Center, 2005-2006, 2006-2007, 2007-2008). The intervention measures were said to have helped in improving the health status of communities by educating volunteers to handle minor health problems and, trying to inculcate in people the unbreakable habit of adopting the cloth filter technique of sieving water. This habit was corroborated by a respondent from the Dagomba area of Gushiegu who said:

> "Even in the absence of filters we used our veils to filter our water before drinking."
>
> Source: Extracts from FGD and Structured Questionnaire, Field Data, 2012

The programme was also credited with encouraging the idea of creating infirmaries and deploying health attendants in selected communities which were once focal points of the programme.

Communities were also empowered by the programme by: teaching community members how to obtain good drinking water; convincing community members on the need to avoid coming into direct contact with surface sources of drinking water; educating community members as to how they got infected with the worm; making community members alert to their task of preventing previous guinea worm infectives from entering surface sources of drinking water; and, by having succeeded in ensuring that everybody got well informed about treating and preventing further infections of guinea worm from occurring.

7.3.7 Other – personal hygiene and toilet facilities

Another 2.9% of respondents indicated that the GWEP improved the health status of guinea worm endemic communities by exposing them to the knowledge and practice of observing good personal hygienic practices (1.5%) and making the provision of community toilet facilities a necessity (1.5%) (CDC, 1989). With regard to knowing and observing good personal hygienic practices a respondent from the former guinea worm endemic area of Nanumba summed it up by saying, "Apart from the eradication of guinea worm much was also learnt about personal hygiene"; while another respondent from the Dagomba area of Tolon indicated that the programme contributed towards improving the health conditions of communities by influencing communities and local government departments to locate toilet facilities within their catchment areas. It must, however, be noted that the practice of keeping their surroundings clean and acquiring the habit of providing community public toilet facilities and toilets for their individual households, was not the core mandate of the

programme. These practices could at best be described as one of the spin-off effects of the programme which inured to the benefit of the people.

7.3.8 Retrogression of GWEP

There was, however, an anticlimax on the contributions of the GWEP to the development of health. This anticlimax came as a retrograde observation of the programme's achievements; because some 1.5% of respondents expressed eroding sentiments on the gains the programme made by indicating that the programme's success in providing potable water threatens to relapse into the state of the Ivorian situation between 1966 and 1991, which is the presence and absence of guinea worm infections in response to the provision of potable water. The voice of 40 year old Issah Naporo from the Dagomaba area of Yendi expressed this anti-climaxic sentiment in the following words:

> The gains the GWEP made in providing us with potable water "is retrogressing again because of inadequate water."
>
> Source: Extracts from FGD and Structured Questionnaire, Field Data, 2012

This retrograde opinion was aptly amplified in the words of some respondents who drew attention to the fact that:

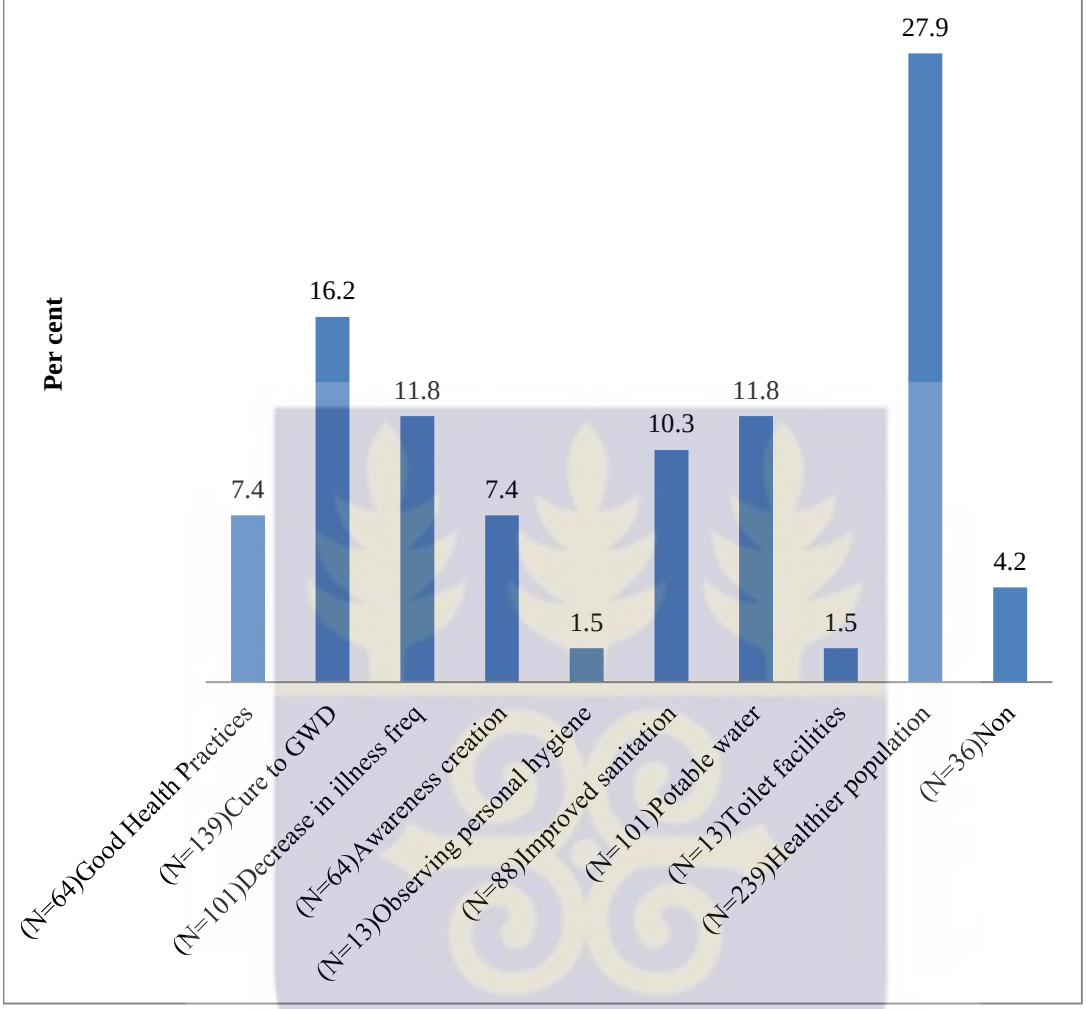
> "It (guinea worm disease) is likely to come back because we are drinking the very water which infected us some time back".
> "GWEP provided us with boreholes; but it (guinea worm disease) will come back because we have started drinking that water again, because our boreholes are spoilt" (Oldman Gaaba).
>
> Source: Extracts from FGD and Structured Questionnaire, Field Data, 2012

Though Issah Naporo and his group may be in the minority, their concern should not be taken lightly. Their concern could materialize some years later in earnest with the return of some water borne diseases, including GWD. This concern comes in the wake of President Jimmy Carter bemoaning the fact that the progress Ghana made in drastically reducing the number of

reported cases of guinea worm between 1989 and 2000 was in danger of being reversed in 2003 due to decreased vigilance on intervention measures. These concerns are supported by two respondents saying that they have the worm in their legs, but that they have not yet emerged. Figures 7.7, 7.8 and Plate 8 are an illustration of the programme's contribution in improving the health status of the people in the former guinea worm endemic areas of the Northern Region.

The importance of eliminating the guinea worm threat in terms of its effects on every day life cannot be over stated (The Carter Center, 2003-2004). In renewing its efforts to eradicate the disease in 2005, Miss Ghana 2005 announced that Guinea worm eradication would be among her major causes (The Carter Center, 2004-2005). Somebody once said that health, education, and agriculture are the building blocks of rural communities. Guinea worm is working against these building blocks. By getting rid of the worm we are making a big difference in thhe lives of a lot of people by helping them stand better on their own feet (The Carter Center, 1998-1999).The observations that GWD and its presence which indicates abject poverty (The Carter Center, 2010-2011) because it incapacitates its victims by making adults incapable of working and children cannot play or attend school has come to be considered a thing of the past.

Figure 7.7: Contribution of GWEP in improving health status



Source: Field Data, September 2012 – January 2013

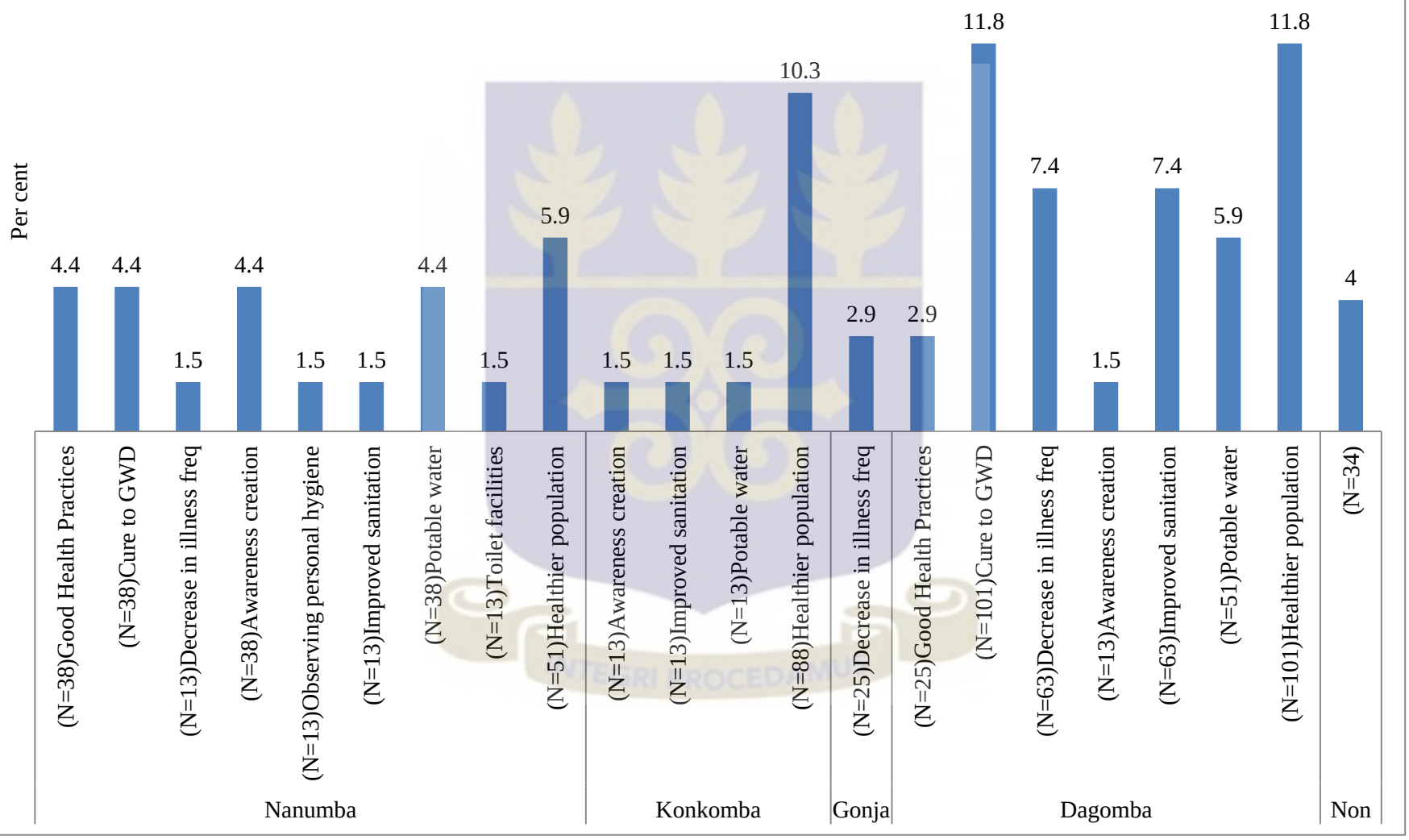
Plate 8: Effects of GWEP on health

A – Practice of filtering drinking water before use

B – A healthier population

Source: Courtesy Carter Centre

Figure 7.8: Contribution of GWEP in improving health status of respondents by Traditional Area



Source: Field Data, September 2012 – January 2013

Throughout its 22 years of operation the GWEP became one of the essential elements of health promotion in Ghana. The programme is inching towards the end of its pre-certification surveillance. With pre-certification surveillance in progress there should be plans of ushering the programme into a second phase of eradication measures aimed at consolidating the programme's hold on the gains it has made in totally eradicating the disease, and to prepare the country towards taking up the task of controlling or eradicating other major endemic eradicable diseases in the country.

7.4 Contribution of the GWEP to socio-economic development in the Region

With its current success of eradicating the disease the GWEP can assume the role of an interim national instrument for channelling financial, economic, and technological resources into the guinea worm freed areas of the Northern Region of Ghana (CDC, 1986).

Most of the guinea worm freed communities in the Northern Region are plagued with poor road network. The programme's activities could bring pressure to bear on the Ministry of Roads and Transport, as it did with the Community Water and Sanitation Agency and the Ghana Water Company to improve the road network in the interior parts of the guinea worm freed districts (CDC, 1990, 1986). This will facilitate an uninterrupted maintenance of water supply facilities and, open up these areas for agricultural inputs and agricultural produce to be transported into the interior farming communities and to the urban consumption centres respectively.

The achievements of the programme are modest with respect to the socio-economic potential of the Guinea Worm Freed Areas in the region. The programme is reported to have contributed indirectly towards improving agricultural production and food self-sufficiency in the area (CDC, 1986, The Carter Center, 1998-1999). The improvement of the agricultural production of these areas made it possible for farmers to cultivate some of their produce for

sale in their district and urban consumption centres. Even though, the cultivation of roots and tubers, especially yams was widespread in these areas during the guinea worm epidemic, the industry has experienced an era of expansion in these areas when the number of cases of guinea worm infections reduced drastically. At a time when the nutritional needs of the Ghanaian population is becoming a serious concern the food produced in the Guinea Worm Freed Areas of the Northern Region should be seen as a vital component in solving part of the local nutritional needs of the country.

The programme has been able to influence communities to re-energize their ailing agrarian economies which suffered a setback partly as a result of the guinea worm epidemic. The programme influenced the socio-economic transformation of the Guinea Worm Freed Areas by playing the suggestive role of pointing out the existence of potential economic opportunities which could be taken advantage of. The programme has on a number of occasions actively engaged other government agencies, for example the Community Water and Sanitation Agency, to provide social infrastructure that is needed to stimulate the development of some community economic initiatives in the Guinea Worm Freed Areas of the Region (CDC, 1986, The Carter Center, 1998-1999).

The other socio-economic effect of the GWEP was in some instances, to analyze the development potential and the population densities of Guinea Worm Freed Areas; and, to define and put forth reliable strategies and approaches to achieve sustainable development in the Guinea Worm Freed Communities of the Northern Region. Additionally, the programme was expected to spearhead an inter-ministerial meeting between the various departments of the Government of Ghana to determine ways of ensuring the proper use and treatment of the

environment and water bodies so as to constantly safeguard the environment from suffering irreversible destructions to the ecosystem (CDC, 1986, 1987, 1990).

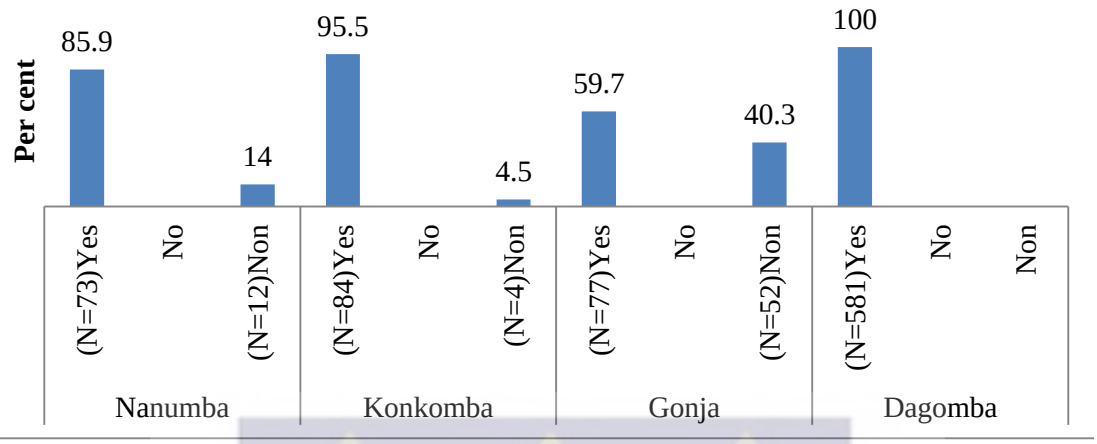
7.5 Contribution of GWEP to economic well being

One of the objectives the research sought to achieve was to investigate the economic trigger and trickle down effects the GWEP may have had on guinea worm endemic areas in the region. In furtherance of this objective the research tried to establish if the programme has had any effect on the economic wellbeing of the people in the guinea worm endemic communities. Responses which came in the form of yes, no, and none were cross tabulated by respondent category, age, sex, education, occupation, and district and examined according to the dominant ethnic groups that occupy the former guinea worm endemic areas in the Northern Region; namely: the Nanumba, the Konkomba, the Gonja, and the Dagomba.

It was found during the examination by ethnic group that an overwhelming 92.3% of respondents were of the opinion that the programme has contributed to the economic wellbeing of the people in the guinea worm endemic communities of the region. The remaining 7.7% of respondents could not tell whether or not the programme has contributed to their economic welfare. Of respondents who were of the opinion that the programme contributed to the economic welfare of the people, 100% came from the Dagomba area, with 95.5% and 85.9% coming from the Konkomba and Nanumba areas respectively, and 59.7% came from the Gonja area.

Of those who could not tell whether or not the programme contributed to the economic welfare of the former guinea worm endemic communities of the region, 40.3% came from the Gonja area and 14% came from the Nanumba area. The remaining 4.5% came from the Konkomba area. Figure 7.9 shows the economic benefit of the programme by Traditional Area of the people living in the former guinea worm endemic areas of the Northern Region.

Figure 7.9: Economic benefit of GWEP by Traditional Area



Source: Field Data, September 2012 – January 2013

At the general level it was found that majority (99.2%) of respondents said the programme has improved the economic well-being of their communities. The remaining 0.8% thought otherwise. Going by the general statistics presented above what readily came to mind was that the programme is widely perceived to have played a positive role in transforming the economic wellbeing of people of the Guinea Worm Freed Areas of the region. With regard to the specific variables of respondent category, age, sex, education, occupation and, district respondents views were subjected to Pearson's Chi-square test to determine which of these variables held the view that the programme has improved the economic wellbeing of individuals and communities. The results in Table 7.3 indicate which variables contributed in improving the economic wellbeing of people in the Guinea Worm Freed Areas of the Northern Region.

Table 7.3: Chi-square test on whether GWEP has improved economic wellbeing

Variable	Value	df	Asymp. Sig
Respondent Category	2.270	1	.132
Age	4.208	5	.520
Gender	.689	1	.407
Education	2.280	2	.320
Occupation	1.214	3	.750
District	18.897	10	.042

Source: Field Data, 2012

Respondents views on whether the programme has improved economic well-being of communities was subjected to Pearson's Chi square test to determine which of the variables is statistically related to the economic welfare of communities which were affected by the programme. At a significance level of 0.05 it was found in Table 7.3 above that, respondents' views on whether the programme has contributed to economic wellbeing was significantly related to district which had a p-value less than 0.05. This indicates the respondents opinions on the programme's contribution to economic wellbeing were related only to district.

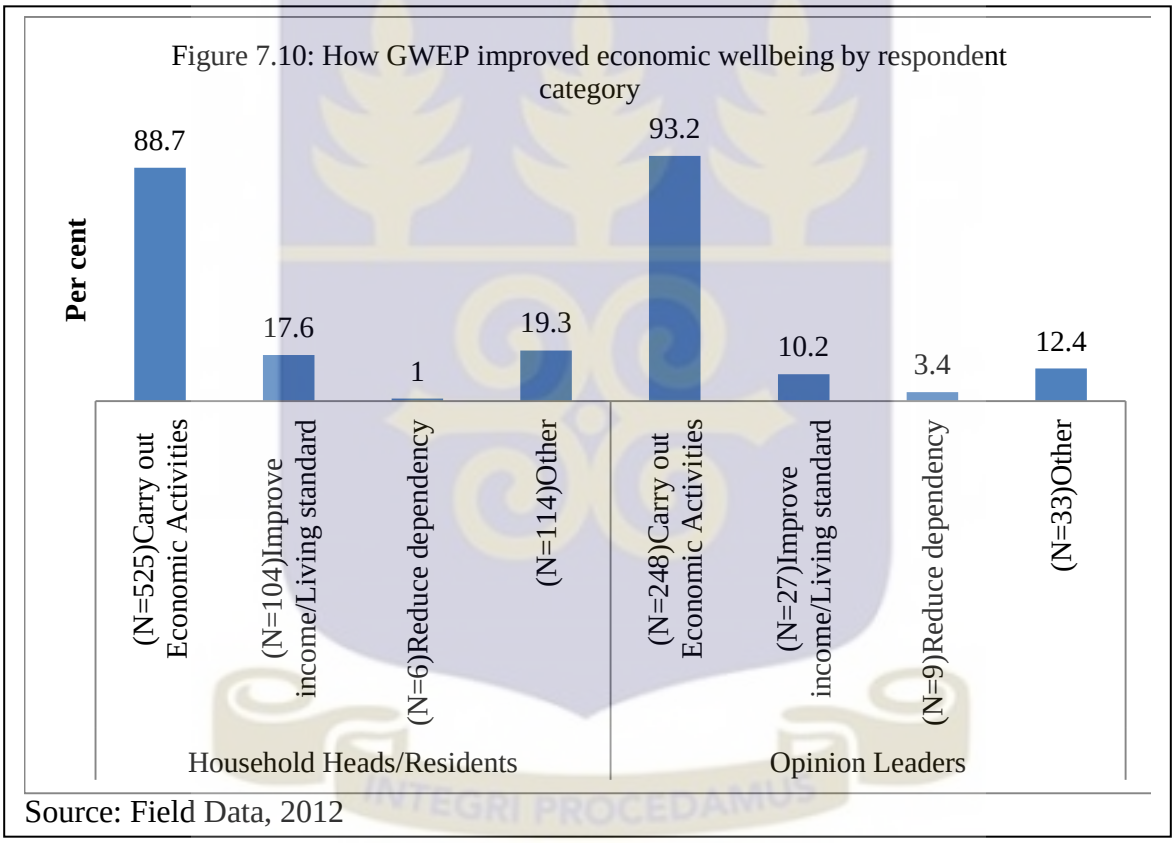


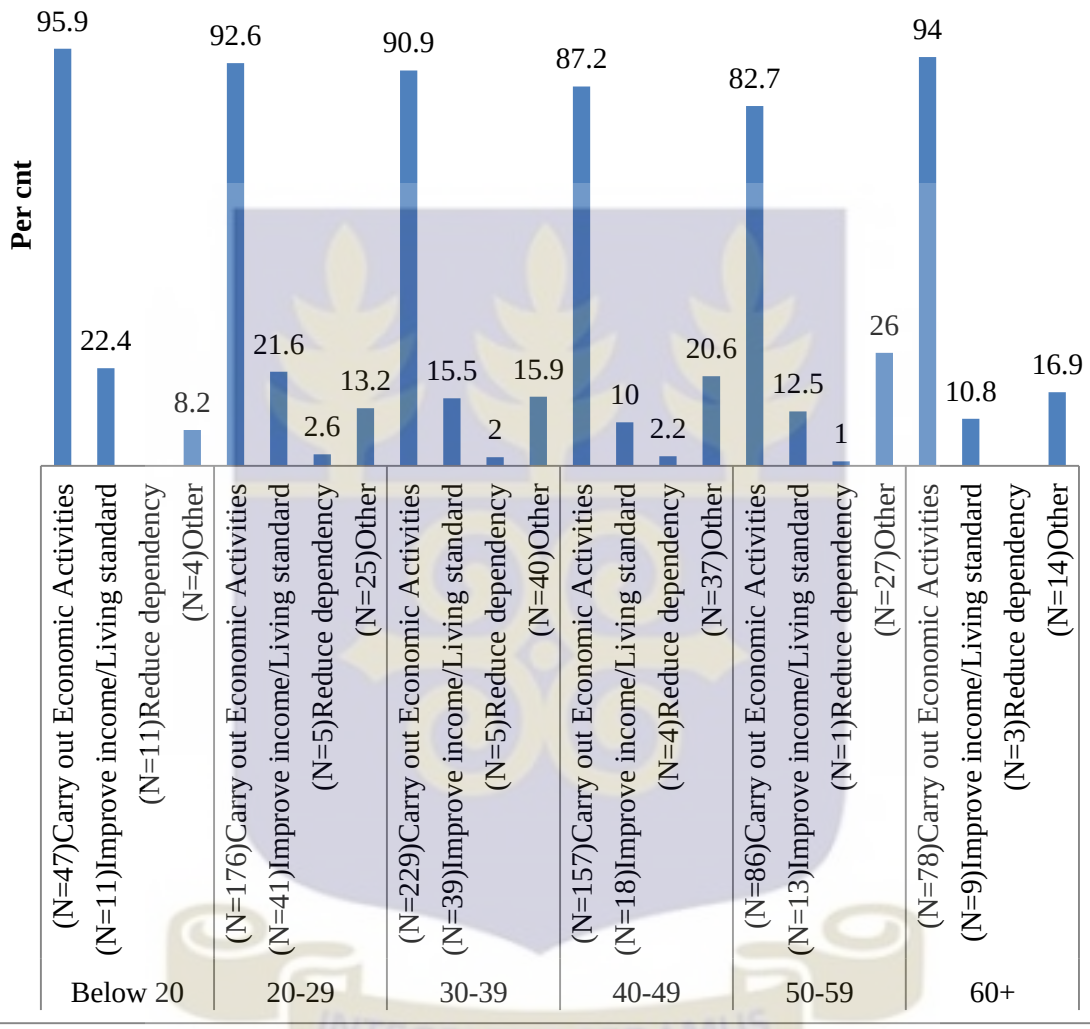
Figure 7.10: How GWEP improved economic wellbeing by respondent category

Source: Field Data, 2012

With respect to the effect the programme had on economic welfare by respondent category. Figure 7.10 showed that majority of opinion leaders (93.2%) and household heads/residents indicated the programme improved economic wellbeing because it made it possible for people to pursue economic activities. This was followed by 17.6% of household heads and 10% opinion leaders indicating that the programme contributed in improving people's

incomes and standard of living. Lastly 4.4% household heads and opinion leaders indicated people now rely on themselves for a living.

Figure 7.11: How GWEP improved economic wellbeing by age

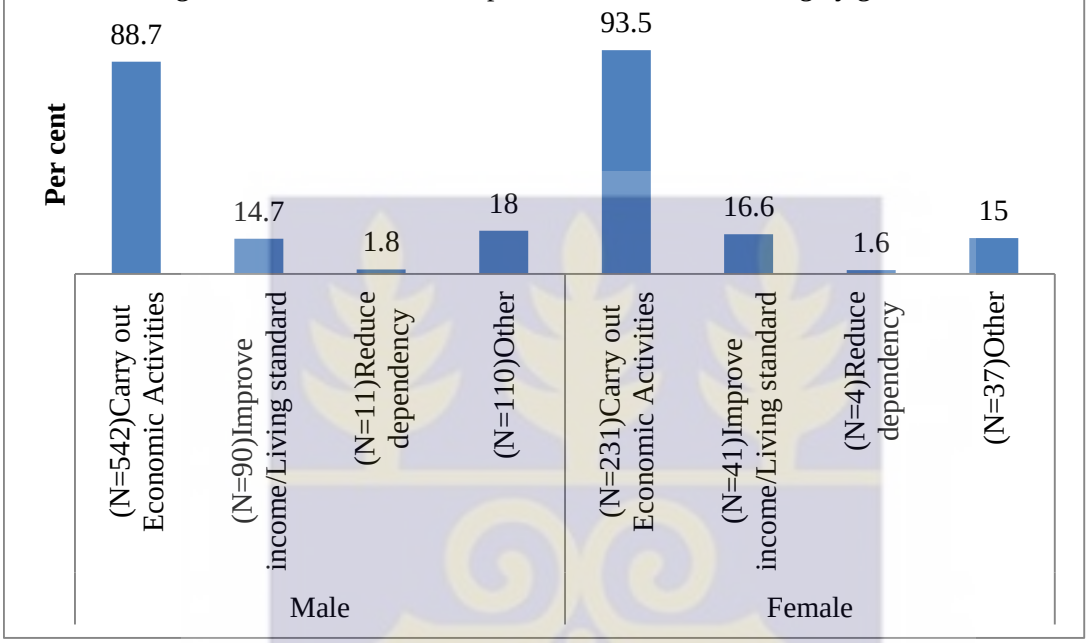


Source: Field Data, 2012

With regard to the effect of the programme on economic wellbeing by age, Figure 7.11 revealed with the exception of the 40 to 59 age group which had 87% and 83% of respondents indicating that programme improved economic wellbeing by making it possible for people to engage in economic activities; respondents in the other age groups all had over 90% subscribing to this view. This was followed by respondents below 23% in all age groups indicating that improved economic wellbeing by either improving their incomes and living

standards or reduced their dependence on others. This indicates that the eradication of the disease was not only a health issue but also one that had a direct relationship on rural livelihoods among the active population.

Figure 7.12: How GWEP improved economic wellbeing by gender



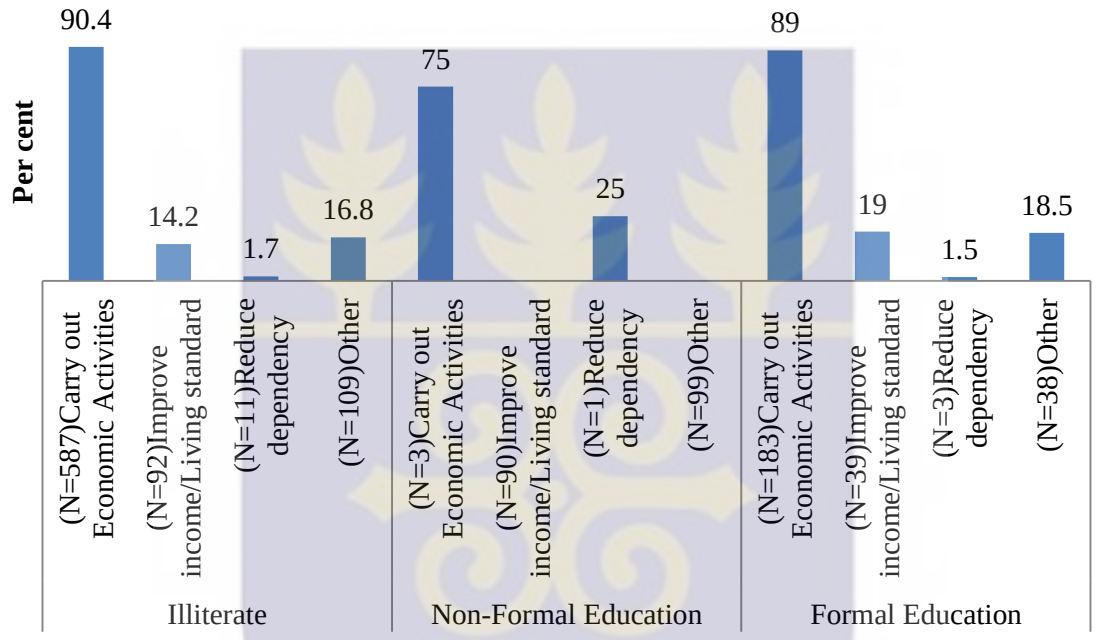
Source: Field Data, 2012

Next was the effect of the programme on economic wellbeing by sex. Figure 7.12 revealed that most females (94%) and males (89%) indicated the programme had improved economic wellbeing by making it possible for people to enjoy improved incomes and living standards. Also about 17% females and 15% males pointed to the fact that the programme improved economic wellbeing by enabling community members to enjoy improved incomes and living standards. A tiny number of males (1.8%) and females (1.6%) indicated that the programme improved economic wellbeing by making people self reliant.

Figure 7.13 shows the effect of the programme on economic wellbeing by education. Going by the responses in Figure 7.13, it was found that 90% of illiterate respondents, 89% of respondents with formal education and 75% with non-formal education indicated the

programme improved economic wellbeing by enabling people to engage in economic activities. Some 25% of respondents with non-formal education indicated the programme improved economic wellbeing by reducing people's dependence on others for help. Also, 19% of formally educated respondents and approximately 14% illiterates indicated the programme improved peoples' incomes and standard of living.

Figure 7.13: How GWEP improved economic wellbeing by education

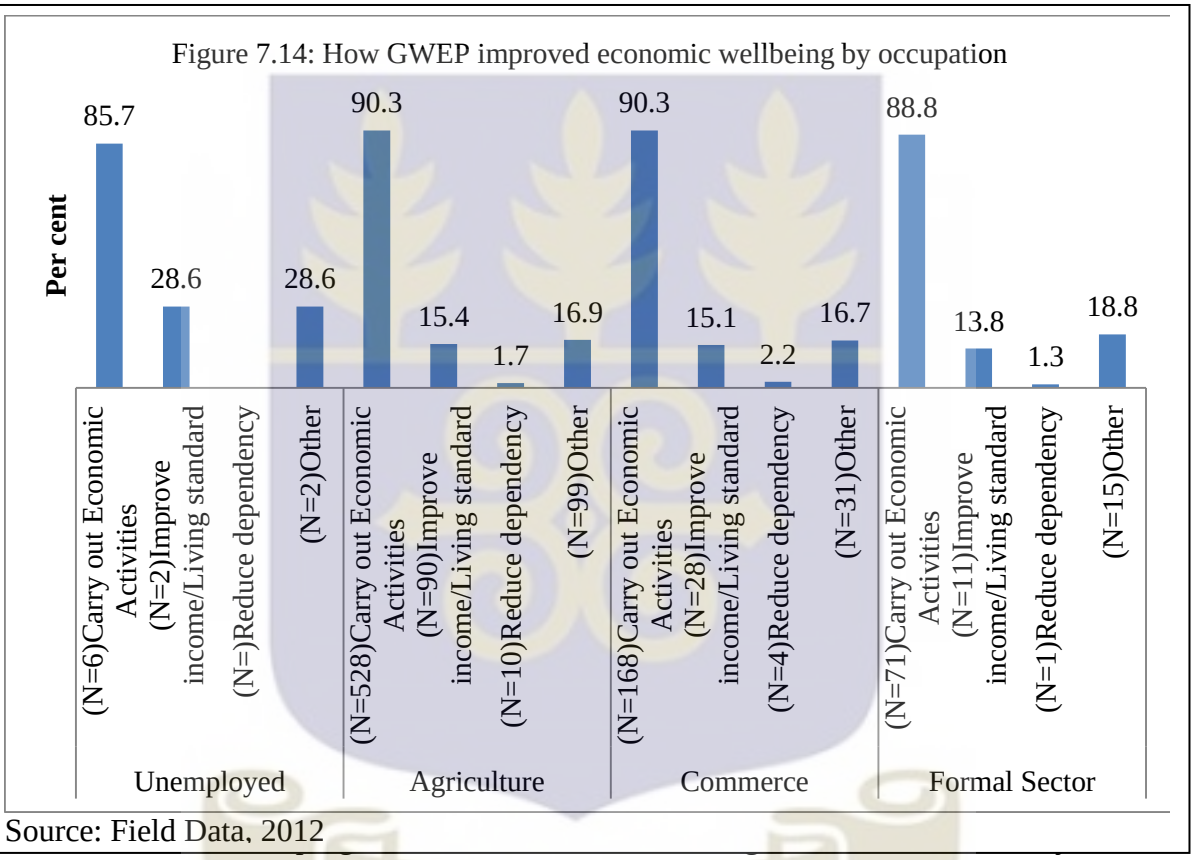


Source: Field Data, September 2012 – January 2013

When it came to the effect of the programme on economic wellbeing by occupation, Figure 7.14 showed that agricultural sector had 90.3% each of respondents indicating the programme improved economic wellbeing by enabling people carry out economic activities and making them enjoy improved incomes and living standards. Some 89% from the agric sector indicated that the programme contributed to economic well being by reducing people's dependence on others. This was followed by the unemployed with approximately 19% of respondents indicating the programme improved economic wellbeing by reducing people's dependence on others and approximately 17% each of respondents indicating that the programme improved economic wellbeing by making it possible for people to engage in

economic activities and enjoy improved incomes and living standards. Lastly, respondents from the commercial sector had approximately 15% each of respondents indicating that the programme improved economic wellbeing by enabling them engage in productive employment and enjoy improved incomes and living standards. Some 14% from the commercial sector were of the opinion that the programme improved economic wellbeing by reducing people's dependence on others.

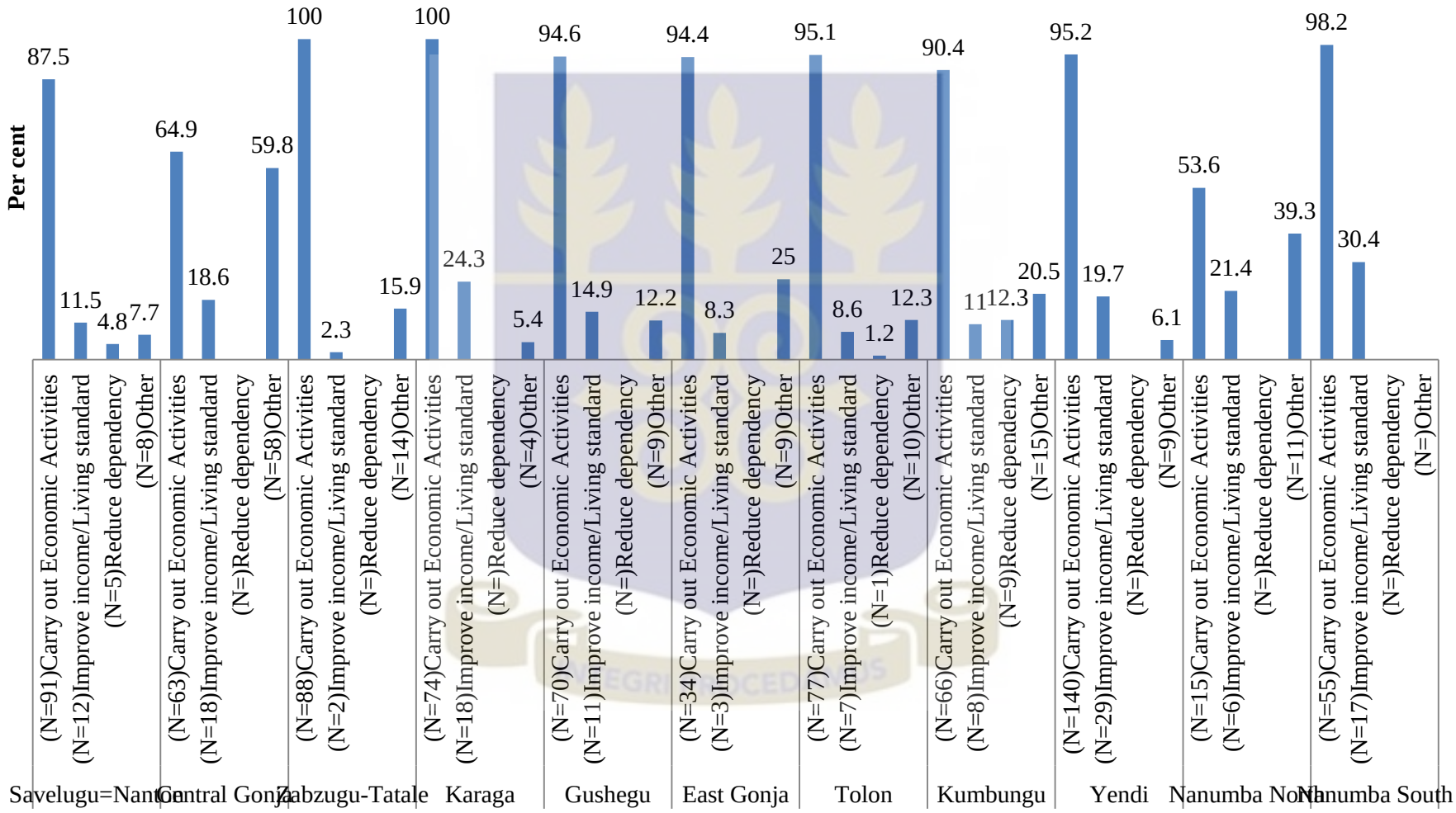
Figure 7.14: How GWEP improved economic wellbeing by occupation



Source: Field Data, 2012

Figure 7.15 showed majority of respondents from, Zabazugu-Tatale (100%), Karaga (100%), Nanumba North (98.2%), Tolon, Yendi and Gushegu approximately 95% each, East Gonja (94.4%), Savelugu-Nanton (87.5%), Central Gonja (64.9%), and Nanumba North (53.6%), indicated the programme improved economic wellbeing. This was followed by respondents Nanumba South, Karaga, Nanumba North, Yendi, Central Gonja, Gushegu, and Savelugu-Nanton, indicating the programme has improved incomes and living standards.

Figure 7.15: How GWEP improved economic wellbeing by district



Source: Field Data, 2012

Table 7.4: Chi-square test on how GWEP improved economic well being

Variable	Value	df	Asymp. Sig
Respondent Category	845.534	810	.188
Age	4088.746	4050	.331
Gender	836.049	810	.256
Education	1397.522	1620	1.000
Occupation	2519.426	2430	.101
District	8461.404	8100	.003

Source: Field Data, 2012

The question of how the programme improved on economic well being with respect to respondent category, age, gender, education, occupation, and district were subjected to Pearson's Chi square test to determine which of them are significantly related to how the programme influenced the economic welfare of communities which were affected by the disease. At a significance level of 0.05 it was found in Table 7.4 above that the programme was significantly related to district which had a p-value which was less than 0.05. These indicate that the programme's effect on economic well being was related only to district.

The findings discussed above were immediately supplemented with qualitative responses to throw more light on how respondents thought the programme affected the economic welfare of communities which were affected by the disease and were subsequently freed from its debilitating health and depressing socio-economic effects.

7.5.1 Productive investment of resources

The topmost economic benefit which respondents thought the GWEP brought to the people of the region was in the area of productive investment of resources (35.7%). According to this group when the epidemic was all over the place people used the little money and other resources they had to treat themselves. But with the eradication of the disease they have realized that such resources are now being put to other uses. This implies that they are making economic progress. In addition to this argument respondents are of the opinion that the provision of boreholes has saved them the cost of using their limited financial resources

in treating polluted water. Expenditure on guinea worm is completely out. This has contributed towards reducing our general expenditure. A 33 year old farmer from the Nanumba area summed up the role of the programme in contributing towards productive investment of resources by saying:

> "Savings can be made when you are healthy; but when you are sick you use such money to attend the hospital instead of saving."

Source: Extracts from FGD and Structured Questionnaire, Field Data, 2012

7.5.2 Improved economic activities

Some 28.5% of respondents indicated that the programme contributed to their economic wellbeing in the form of they experiencing improvements in their economic activities. This opinion was advanced because they felt the education and encouragement they received from the programme improved their economic activities. A 52 year old farmer from the guinea worm endemic area of Nanumba said:

> "With the help of the eradication programme people are now well and are able to take charge of their businesses which in turn has improved economic well being."

Source: Extracts from FGD and Structured Questionnaire, Field Data, 2012

7.5.3 Improved incomes

About 14.3% of respondents reported that the programme contributed to the economic progress of their areas through improved incomes. This became possible because they had more people engaged in farming and other rural livelihood activities and the buying and selling of their produce. A 62 year old farmer from the former guinea worm endemic area of Nanumba perfectly captured the mood of respondents on this subject when he said:

> "Economically the programme has helped because a healthy life constitutes a healthy work, and a healthy work constitutes a healthy income."

Source: Extracts from FGD and Structured Questionnaire, Field Data, 2012

7.5.4 Removal of obstacle to economic growth

Another 14.3% of respondents drew attention to the fact that through the programme's activities and presence in the former guinea worm endemic areas, the programme was able to remove one of their major obstacles for economic growth. This triggered a chain of economic activities which has inured to their benefit. The words of a respondent from the Nanumba area served as the bedrock for this opinion when he said:

> "With regard to economic wellbeing, there has been some significant improvement because health which is considered the major factor for economic growth has been solved by eradicating the guinea worm disease and so a good improvement is seen in economic wellbeing."
>
> A respondent from the former Gonja endemic area of Yapei also said:
>
> "People who were down with the disease were economically affected. The trade that they indulged in stood still, as they could not move about to trade. Mostly farmers, they are now free to go to farm and work."

Source: Extracts from FGD and Structured Questionnaire, Field Data, 2012

7.5.5 Job security

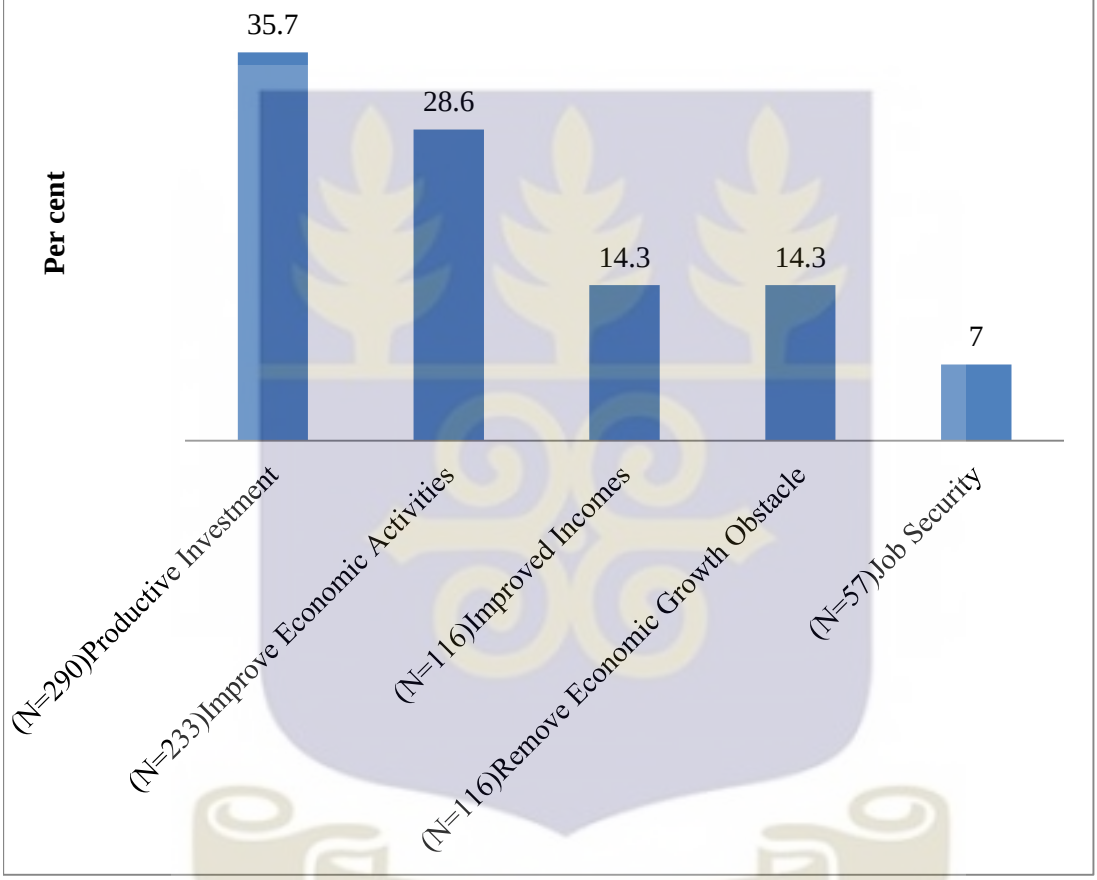
The remaining 7% of respondents felt that the work and success of the programme has contributed to their economic wellbeing by creating job security for some who were engaged in some form of paid employment. The inhibitions which the disease brought have been removed through the initiative of the programme, thus improving the economic wellbeing of people engaged in some form of paid employment in the area. Another respondent from the Nanumba area contrasted the situations before and after the implementation of the programme to illustrate how secure wage earners in the former guinea worm endemic areas have become in terms of security of employment, when he said:

> "During the guinea worm epidemic one who was affected could lose his job; thereby affecting his economic wellbeing. But today it is seen that almost everybody is free from it and can attend to his or her work."

Source: Extracts from FGD and Structured Questionnaire, Field Data, 2012

From the above responses it was observed that community members were generally of the opinion that the GWEP had contributed towards improving the economic well being of individuals and communities as a whole. Figure 7.16 gives a summary of the contribution the programme made towards improving the economic wellbeing.

Figure 7.16: Contribution of GWEP to economic wellbeing



Source: Field Data, September 2012 – January 2013

7.6 Contribution of GWEP to social wellbeing

Another objective the research sought to achieve was to investigate the social effects the GWEP may have had on the guinea worm endemic areas of the region. In furtherance of this objective the research tried to establish the programme's effect on the social wellbeing of the people of these areas. Responses which came in the form of yes, no, and none were cross tabulated by respondent category, age, sex, education, occupation, and district and examined according to the dominant ethnic groups that occupy the region.

With respect to respondents' opinions on social wellbeing it was found that 99.9% of respondents said the programme has improved the social well-being of their communities, whilst some 0.1% thought otherwise. The question as to whether the GWEP has improved the socio-economic wellbeing of people in the Guinea Worm Freed Areas of the Northern Region can be said to be generally successful. This is demonstrated by the varying extents to which the specific variables of respondent category, age, sex, occupation, and district were considered to be related to the programme improving the socioeconomic wellbeing of respondents.

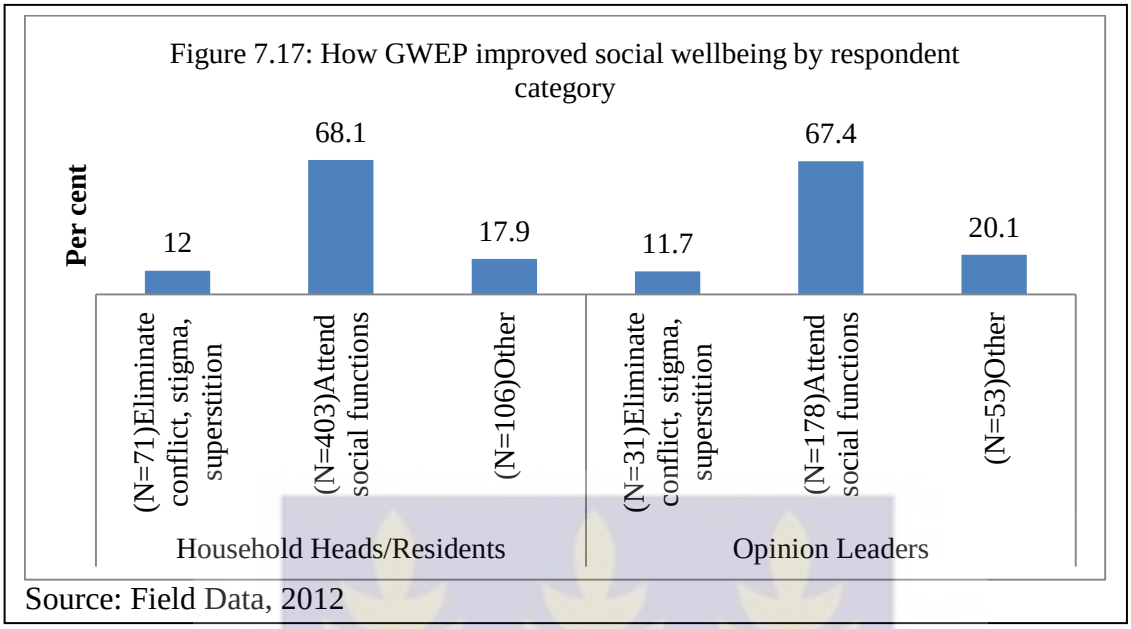
It is seen that the programme played a positive role in transforming the social wellbeing of people of the region. With regard to specific variables, respondents' views were subjected to Pearson's Chi-square test to determine which of these variables indicate that the programme has improved the social wellbeing of individuals and communities.

Table 7.5: Chi-square test on whether GWEP has improved social wellbeing

Variable	Value	df	Asymp. Sig
Respondent Category	2.236	1	.135
Age	3.782	5	.581
Gender	2.485	1	.115
Education	323	2	.851
Occupation	.468	3	.926
District	9.628	10	.474

Source: Field Data, 2012

At a significance level of 0.05 it was found in Table 7.5 above that, respondents views on whether the programme has contributed to social wellbeing was not significantly related to social well being because all the variables had p-values above .05.

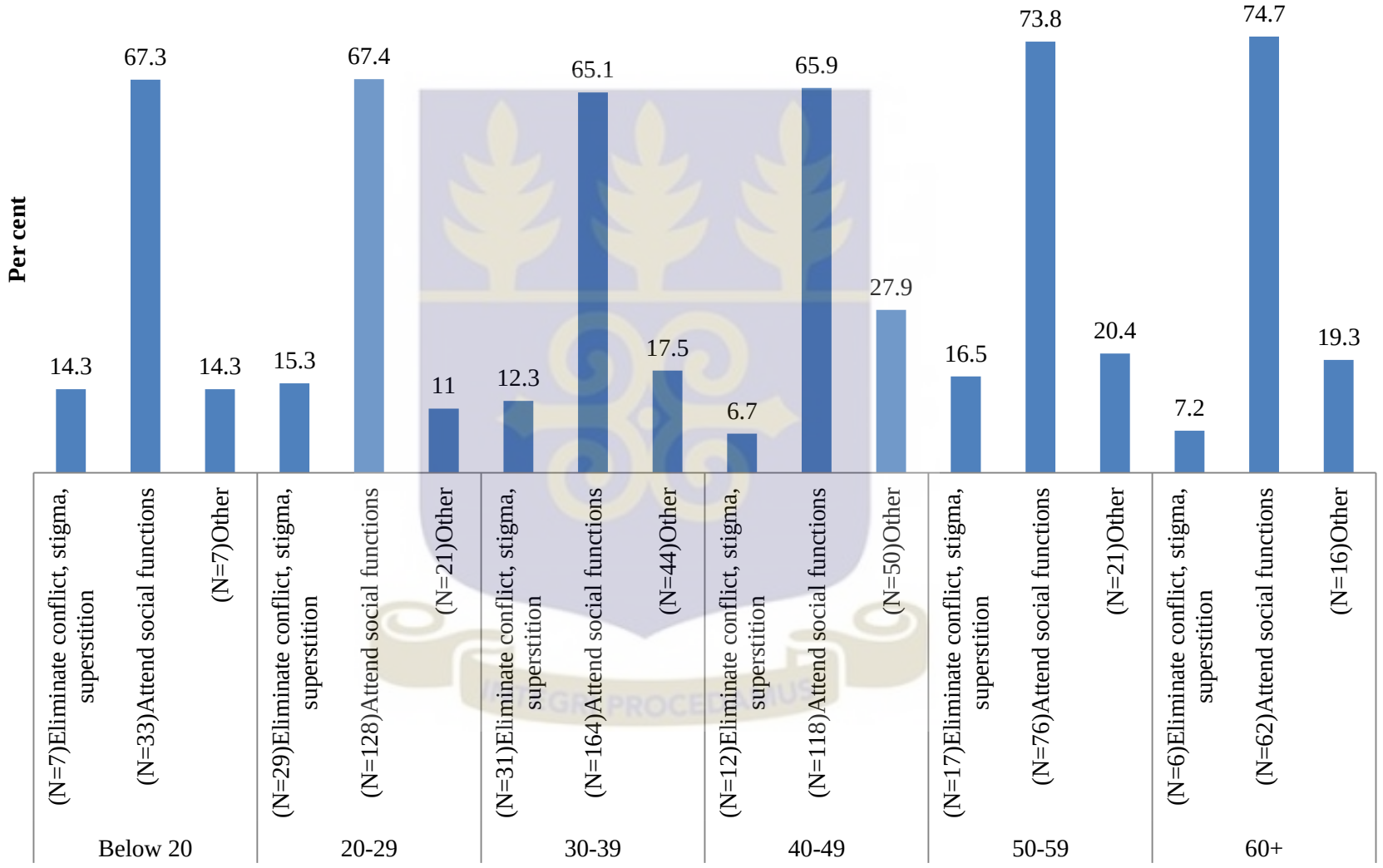


Source: Field Data, 2012

When it came to the question of how the programme transformed social wellbeing by respondent category, Figure 7.17 revealed that an almost equal proportion of household heads/residents (68.1%) and opinion leaders (67.4%) indicated the programme positively affected social wellbeing by making it possible for people to attend social functions and visit relations. Also 12% each of household heads/residents and opinion leaders indicated that through the programme's activities conflicts, stigmatization, superstition and suspicion on the disease has been removed from their communities.

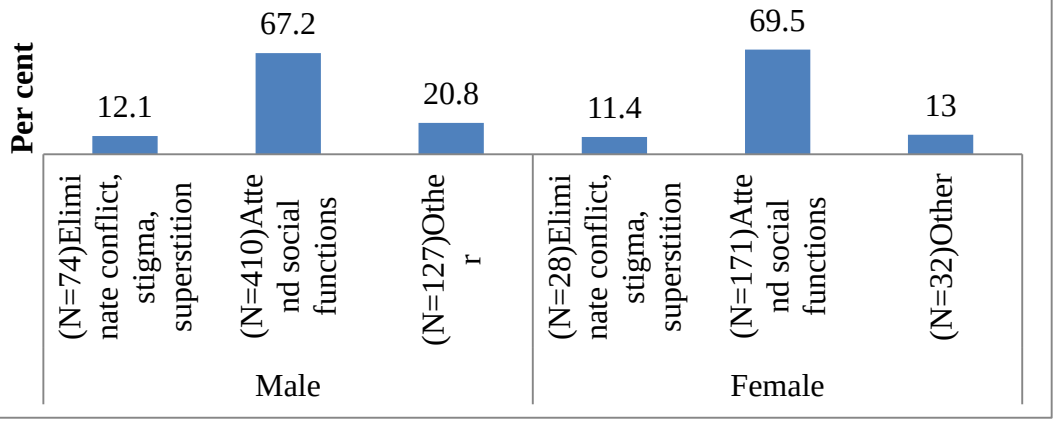
When it came to the ways in which the GWEP transformed social wellbeing by age, Figure 7.18 revealed that respondents in all age groups with an average of 69% for each age group indicated the programme has improved social wellbeing by making it possible for every body to participate social functions in their communities. It was realized that an almost even distribution of responses from the following age groups, 50-59 (16.5%), 20-29 (15.3%), below 20 (14.3%), and 30-39 (12.3%), indicated the programme improved social wellbeing by removing stigma, conflicts, superstition and suspicion about the disease from their communities.

Figure 7.18: How GWEP improved social wellbeing by age



Source: Field Data, 2012

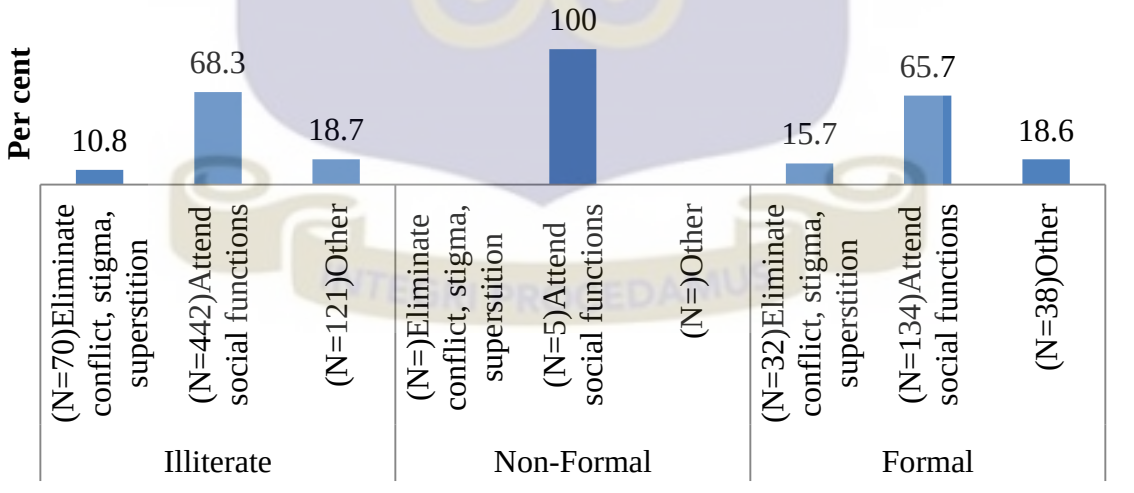
Figure 7.19: How GWEP improved social wellbeing by gender



Source: Field Data, 2012

With regard to the programme on social wellbeing by sex it was found, in Figure 7.19 that approximately 70% females and 67% males indicated the programme's effect on social wellbeing was realized by making it possible for all to participate in social functions. About 12% respondents from all sexes thought the programme's effect on social wellbeing came in the form of eliminating conflicts, stigma, suspicion and superstition.

Figure 7.20: How GWEP imprroved social wellbeing by education

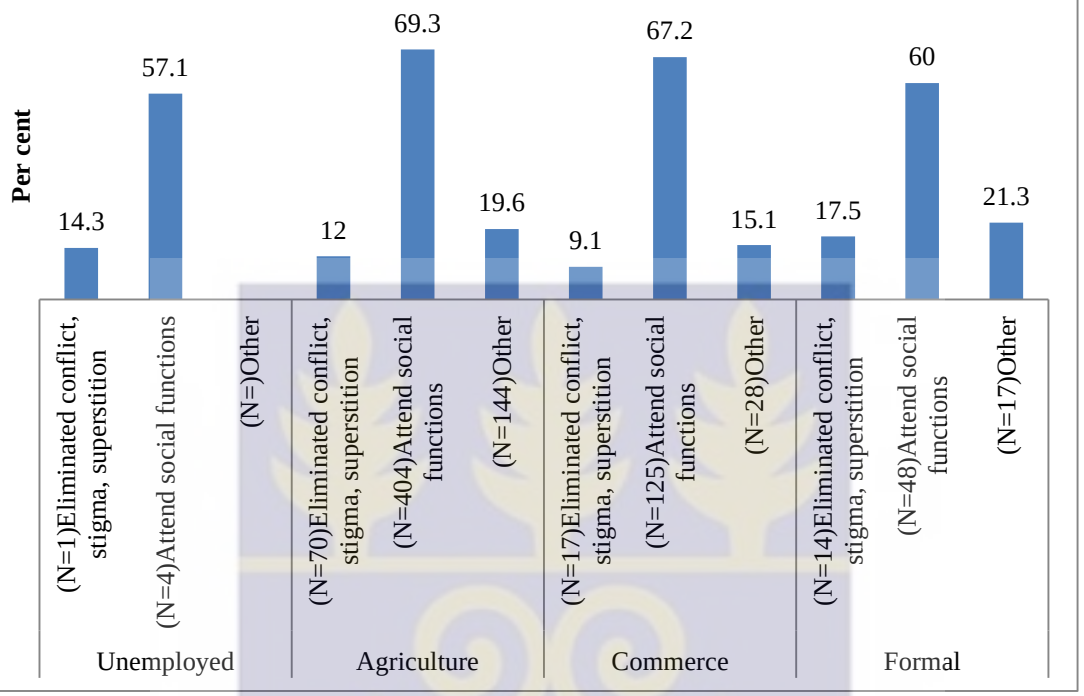


Source: Field Data, 2012

On the programme's contribution to social wellbeing by education, it was found from Figure 7.20, that those with non-formal education (100%), without any form of education (68.3%),

and formal education (66%) indicated social wellbeing has improved because people now attend social functions.

Figure 7.21: How GWEP improved social wellbeing by occupation

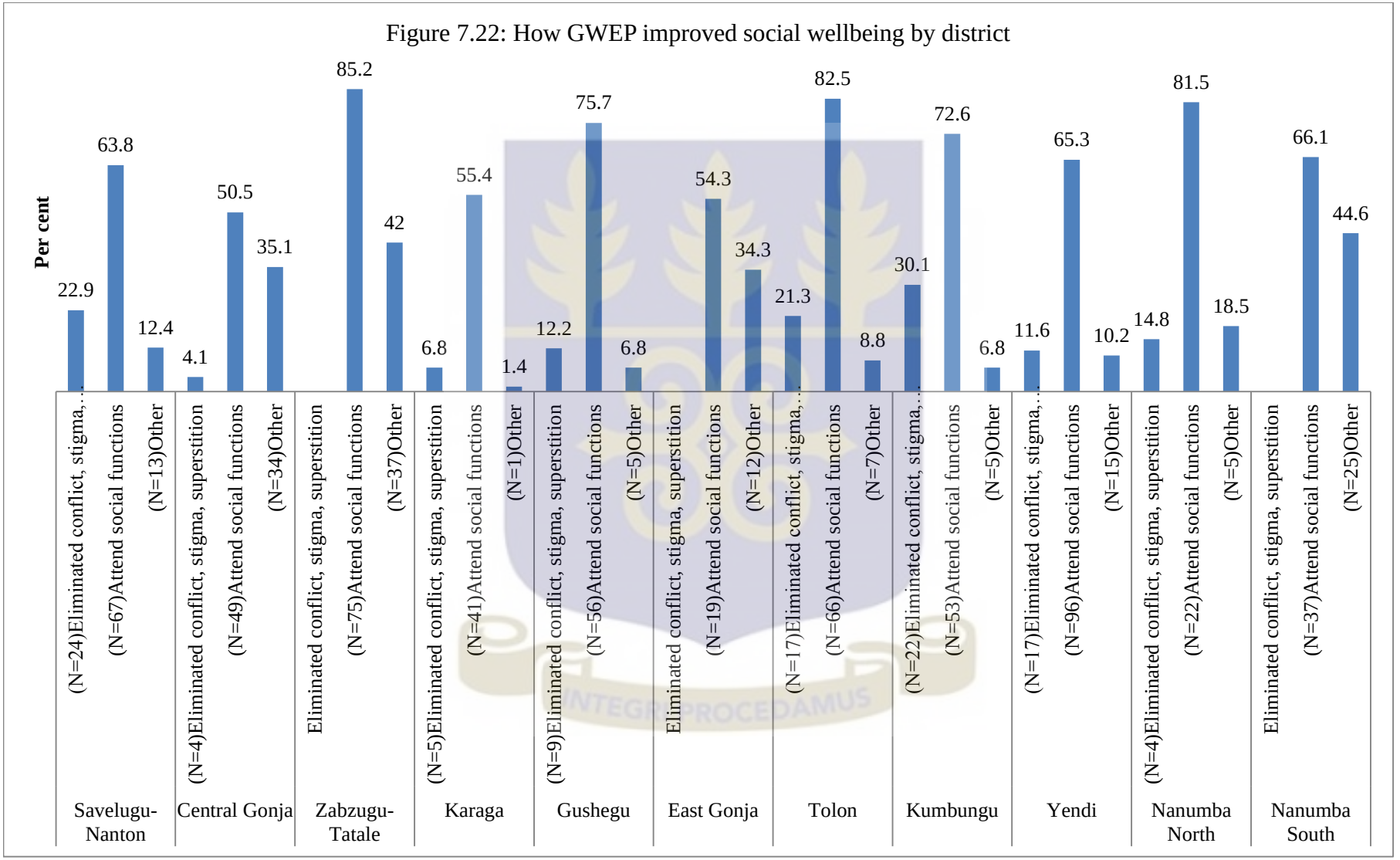


Source: Field Data. 2012

It was found from Figure 7.21 that majority of respondents who said the programme enabled people to participate in social activities at the community level came from the agric sector (69.3%), followed by the commercial sector (67.2%), the formal sector (60%), and the unemployed (57%). With regard to eliminating conflict, stigma, and superstition an average of 13% of respondents from all sectors and the unmployed subscribed to this view.

From Figure 7.22 it was realized that the programme's effect on social wellbeing by district showed that majority of respondents with an average of 68.5% from all districts indicated the programme made it possible for people to participate in social functions. Other districts worth reporting on were Kumbungu, Savelugu-Nanton, Tolon, Nanumba North, and Yendi and Gushegu indicating that the programme eliminated conflicts, stigma, and superstition associated with the disease.

Figure 7.22: How GWEP improved social wellbeing by district



Source: Field Data, 2012

Of the respondents who were of the opinion that the programme has contributed to the social welfare of the people in the former guinea worm endemic areas 92% and 91.3% came from the Nanumba and Dagomba areas respectively. This was followed by 52% coming from the Gonja area, with the remaining 30.6%coming from the Konkomba areas respectively.

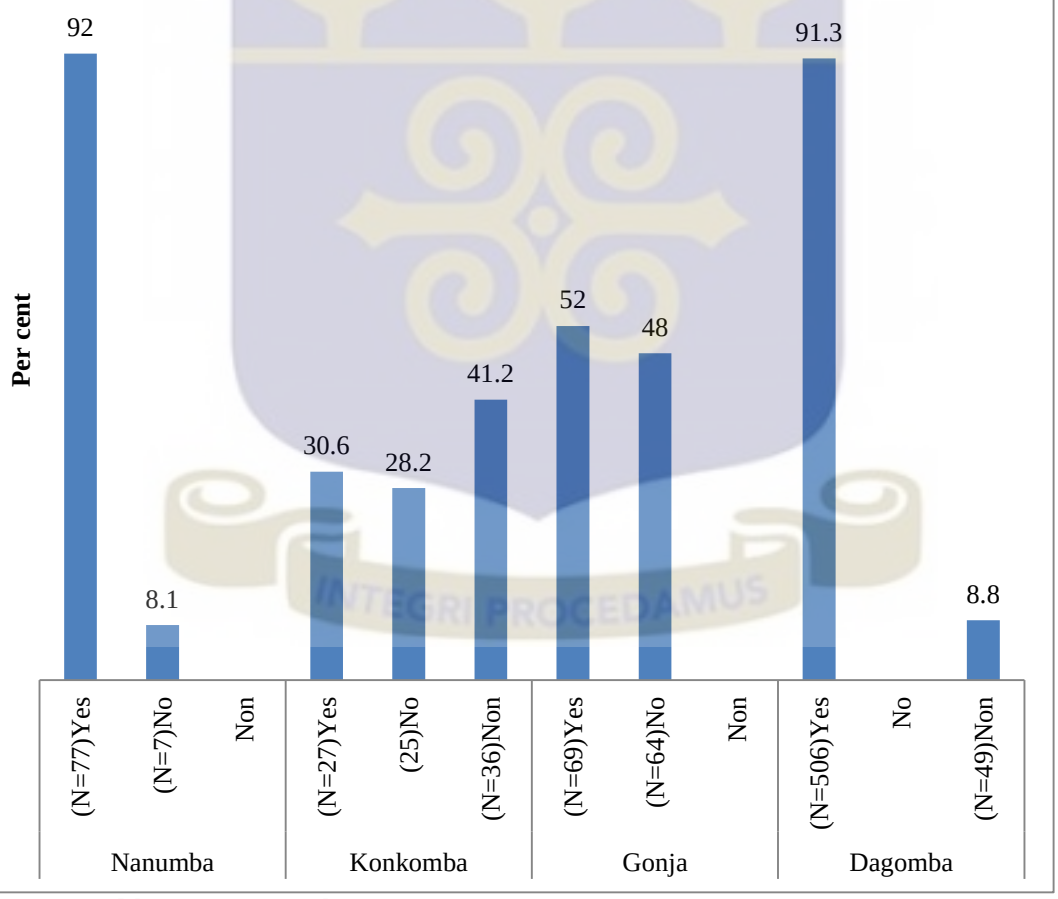
In the case of those who thought the programme did not contribute to their social welfare 48% of respondents came from the Gonja areas, while 28% and 8% of respondents came from the Konkomba and Nanumba areas respectively. Of those who could not tell whether or not the programme has contributed to the social wellbeing of the people in the former guinea worm endemic areas 41% and 8.8% of respondents came from the Konkomba and Dagomba areas respectively.

From the above analysis, the pattern that emerged was that people had varied opinions as to whther or not the programme has had an effect on their social wellbeing. Of those who thought the programme had contributed positively to their social wellbeing majority came from the Dagomba area. They were followed by those from the Gonja area and then the Nanumba area. The Konkomba Guinea Worm Freed Area came last. With respect to those who did not think the programme has affected their lives people in the Guinea Worm Freed Area of Gonja came first, followed by those in the Konkomba and Nanumba areas. However, the Guinea Worm Freed Areas of Dagomba and Konkomba had people who thought the programme cannot be credited with any positive or negative social change in their communities.

It could therefore be said the responses that were obtained pointed to the fact that there were a mixture of positive and negative social effects the programme had on the lives of the people

of the Guinea Worm Freed Areas. On the whole there was the general agreement among all the ethnic groups that the programme contributed positively to the social welfare of the former guinea worm endemic communities in the region. The responses of those who did not think the programme contributed to the social welfare of people could not be discounted as 48% and 28% of responses came from the Gonja and Konkomba area. Figure 7.23 gives geographic distribution of the opinion of respondents on whether or not the programme had any effect on the social welfare of the people in the former guinea worm endemic areas of the Northern Region.

Figure 7.23: Social benefit of GWEP by Traditional Area



Source: Field Data, September 2012 – January 2013

Table 7.6: Chi-square test on how GWEP improved social wellbeing

Variable	Value	df	Asymp. Sig
Respondent Category	830.683	792	.165
Age	4040.494	3960	.182
Gender	798.273	792	.431
Education	1479.231	1584	.971
Occupation	2443.352	2376	.164
District	8377.897	7920	.000

Source: Field Data, 2012

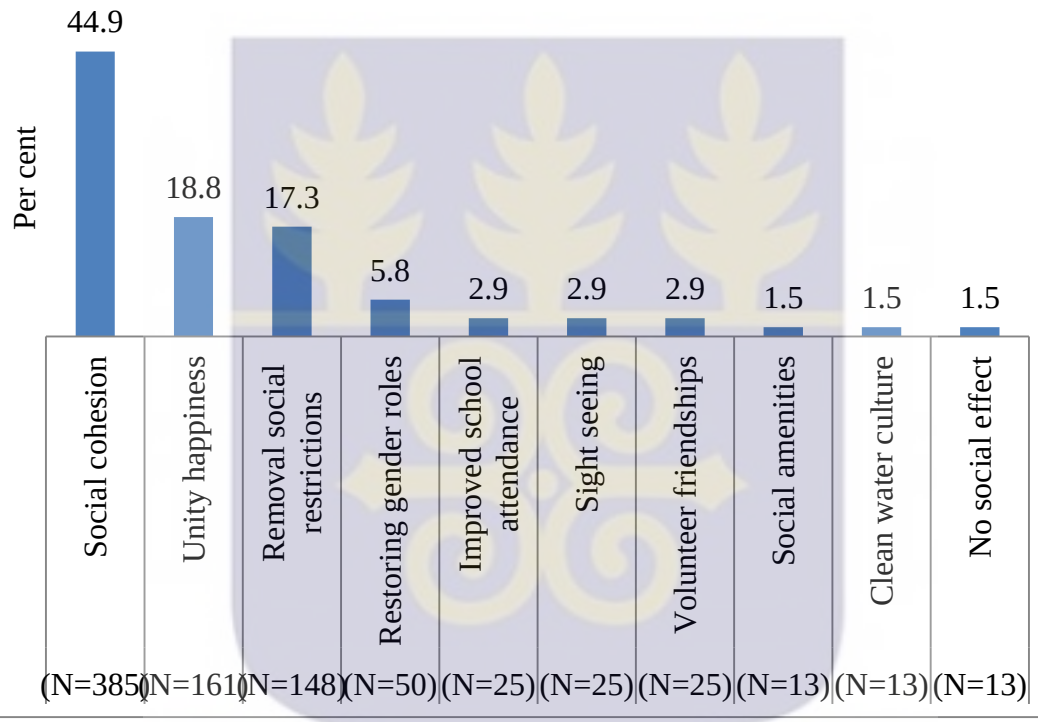
With regard to how the programme improved on social well being with respect to respondent category, age, gender, education, occupation, and district were subjected to Pearson's Chi square test to determine which of them are statistically related to the programme influencing the social welfare of communities which were affected by the disease. At a significance level of 0.05 it was found in Table 7.6 above that the programme was significantly related to district which had a p-value of .001, indicating that the programme had a positive effect on social well being with respect to only district. It, however, turned out that at the same significance level respondent category, gender, education, and occupation were not significantly related to the programme improving social well-being as these variables had p-values higher than 0.05.

The findings discussed above were immediately supplemented with qualitative responses to throw more light on how respondents thought the programme affected the social welfare of communities which were affected by the disease and were subsequently freed from its debilitating health and depressing socio-economic effects.

In furtherance of this the survey found that respondents views on the contribution of the programme to the social welfare of the people were as follows: social cohesion – 44.9%; unity and happiness – 18.8%; removal of social restrictions – 17.3%; and restoring gender

roles – 5.8%. Next on the list was improved school attendance, sightseeing, and volunteer related friendships each registering – 2.9%. The enjoyment of social amenities, the adoption of clean water culture, with others thinking the programme had no social effect, had 1.5% each of respondents stating these opinions. These responses are shown in Figure 7.24 and the details of these responses are discussed below.

Figure 7.24: Contribution of GWEP to social wellfare of people



Source: Field Data, September 2012 – January 2013

7.6.1 Social cohesion

In zeroing in on the possible reasons why respondents felt the GWEP has contributed to the social welfare of the people 44.9% of respondents indicated that the programme contributed to the social welfare of the people by helping them to achieve some amount of social cohesion in their communities. This, they say, the programme achieved by reversing the perception that, healthy people did not like to associate themselves with guinea worm infectives. Secondly, the programme brought the disease under control, making it possible for those who were frequently immobilized by the disease to reintegrate themselves in the social

activities of their areas. Thirdly, the programme removed the social problem of people thinking that members of their communities used malevolent powers to afflict others with the disease. The total effect of the programme's effort in the area of social cohesion was that family bonds got strengthened. Below are samples of the views of some respondents indicating why they think the programme enhanced social wellbeing by helping them to improve upon their social relationships:

> "People who were affected thought the disease was caused by others; and this brought social problems; but today it is realized that it is not true; and, this has improved upon social relations."
>
> "People were enabled to attend community gatherings like funerals, outdoorings, and festivals." and,
>
> "Relations have been strengthened because people who are free of the worm are now able to visit friends and patch up their relations."

Source: Extracts from FGD and Structured Questionnaire, Field Data, 2012

7.6.2 Unity and happiness

The second reason which came under the notice of the research with respect to the programme's contribution to the social welfare of people in guinea worm endemic areas of the Northern Region was in the area of unity and happiness (18.8%). Respondents in this category said the programme's contribution to social wellbeing of people in the guinea worm endemic areas of the region thought this was made possible through the programme's activities, which took misery away from sufferers of the disease. Everybody is considered to be free of the effects of the disease, thus making it possible for people to relate well in their communities. Sorrow, some say, has been taken away because people no longer see their relatives suffer with the affliction. Communities have been relieved from the prolonged periods of being stressed; and the programme has brought unity unlike before. Some selected responses which may be considered to aptly capture the mood of communities are presented here to shed light on the feeling of unity and happiness:

"We don't witness it among our relatives which create unnecessary sympathy. We are now happy with each other;"

"It used to create too much pity. It is no more like that. Like how this guy has visited, if it were those days by now he would have been indoors;" and,

"It could make a whole community restless for a whole year."

Source: Extracts from FGD and Structured Questionnaire, Field Data, 2012

7.6.3 Removal of social restrictions

The removal of social restrictions (17.4%) came as the third reason why respondents felt the GWEP added value to their social wellbeing. The reasons that were elicited from the views of respondents were that through the programme's success the inhibitions which the disease created have been removed, by eliminating discrimination against infected people. This has resulted in people associating freely with each other in their communities. Guinea worm infectives used to shy away from public places; but with the education and sensitization which the programme carried out infected people accepted their condition as one which did not condemn them to a life of seclusion. Lastly, security against fear of getting infected as a result of visiting a guinea worm patient was built among community members. Here again, one or two insightful remarks from respondents may shed light on the social restrictions which infectives suffered and which were subsequently removed through the activities of the programme:

"Like how we are seated, in those days people who were infected with guinea worm were not comfortable sitting with the rest;" and,

"As we are seated here if someone was infected we would have isolated the person because of the flies and the smell."

Source: Extracts from FGD and Structured Questionnaire, Field Data, 2012

7.6.4 Restoring the balance of gender related responsibilities

It was also found that respondents felt the balance of functions in gender related responsibilities in the former guinea worm endemic communities which was disrupted during the guinea worm epidemic has been restored as a result of successfully eradicating guinea worm infections (5.8%). These respondents have argued that the success of the programme has freed them of the effects of the disease, thus making it possible for them to effectively assume their respective household responsibilities.

7.6.5 Improved school attendance, sightseeing, and volunteer related friendships

Some 8.7% of respondents mentioned improved school attendance (2.9%), sightseeing (2.9%), and volunteer related friendships (2.9%) as some of the contributions the programme made towards improving the social welfare of the people. On the social benefit of sightseeing respondents from the former guinea worm endemic area of Gonja reported that some "people got to know Tamale when they were taken to the Case Containment Centres." The social benefit of volunteer related friendships was achieved in the form of volunteers interacting with one another. Through the training sessions of the programme volunteers were brought together and they got to know each other and later became friends.

7.6.6 Provision of social amenities and the practice of clean water culture

A consolidated group of 2.9% of respondents pointed to the fact that the GWEP contributed to the social wellbeing of their former guinea worm endemic areas by influencing government and some international government agencies to provide them with social amenities (1.5%), and successfully getting members of their former guinea worm endemic areas to practice the culture of using only potable water (1.5%). The social amenities that were provided came in the form of potable water being supplied in most former guinea worm endemic areas in the Northern Region. The rural water supply facilities in the Northern Region were provided in the form of boreholes, small community pipe systems, and the rain harvest system (CWSA, 2012).

There was, however, a group of respondents who felt that apart from eradicating the disease, the programme has brought nothing to bear on their social wellbeing (1.5%). This group was so much in the minority as to render their opinion not worth taking notice of. But it was realized from Focus Group Discussions that this group of respondents expected more from the programme by way of contributing directly in improving their social well being. A respondent from the Nanumba area and another from the Dagomba area each had the following observations to make on the non-contribution of the programme to the social welfare of former guinea worm endemic areas:

> "The GWEP has had no effect on the social wellbeing of communities after the programme was implemented;" and,
> "There is still poverty."

Source: Extracts from FGD and Structured Questionnaire, Field Data, 2012

CHAPTER EIGHT

BEHAVIOURAL CHANGE AFTER THE IMPLEMENTATION OF THE GUINEA WORM ERADICATION PROGRAMME

8.1 Introduction

In addressing the fourth objective and third proposition of the research, this chapter tried to find out how the GWEP changed people's behavior towards the disease and the effect these changes have had on their environment. Prior to the implementation of the programme the people of these endemic areas were at their wits end as to how to overcome the disease which had plagued them for so many years. Most of them did not think their sources of drinking water were responsible for the disease, while the enlightened few who knew that their sources of drinking water made them vulnerable to the infectious agent of the water flea could not prescribe a solution as to how they could avoid coming into contact with the infectious agent of the guinea worm.

However, with the implementation of the programme people got educated on how they always caught their infections of guinea worm and were also educated on how to avoid catching infections of the disease. As a result of their acquired knowledge on how they can avoid catching infections of the disease, it was expected that the GWEP may have changed community members' behaviour towards the disease and their general attitude towards avoiding the infectious agent of the guinea worm and other parasitic infections which dogged their paths as a result of falling ill with the disease.

8.2 Behavioural change towards guinea worm infection after the GWEP

The objective that guided the conduct of this part of the research was to find out if the GWEP had changed people's behaviour towards GWD in the region. Responses which came in the form of yes, no, and none were examined according to the dominant ethnic groups that

occupy the former guinea worm endemic communities in the Northern Region, namely: the Nanumba, the Konkomba, the Gonja, and the Dagomba.

In addressing the above objective respondents were asked if they thought the programme had changed people's behaviour towards the disease. It was found that 63% of the respondents were of the opinion that the programme had changed people's behaviour towards the disease and their overall attitude towards health and sanitation, while 37% did not think so.

It was found that respondents' opinions as to whether the programme had an effect on people's behaviour towards the disease in the region by ethnic group was almost balanced. Some 43.8% of respondents were of the opinion that the programme had an effect on people's behaviour towards the disease, while 40% thought otherwise. The remaining 16% could not tell whether or not the programme had any effect on the people's behaviour towards the disease. Majority of respondents who thought the programme had an effect on people's behaviour towards the disease came from the Dagomba area (30.9%), followed by the Gonja area (9.7%). The Nanumba area had 2.9% of respondents indicating that the programme has had an effect on their behavior towards the disease, while a sprinkling of 0.9% of respondents from the Konkomba area gave their support to the view that the programme has had an effect on their behavior towards the disease.

Of respondents who did not hold the view that the programme had an effect on their behaviour towards the disease, majority came from the Dagomba area (21.7%), followed by the Konkomba and Nanumba areas, with 8.3% and 6.1% respectively of respondents not subscribing to the view that the programme did not affect their world view towards catching infections of guinea worm in the Northern Region. The remaining 4% of respondents who did

not hold the view that the programme has had an effect on their behaviour towards the disease came from the Gonja area.

From the above analysis the pattern that emerged was that people had varied opinions as to whether or not the programme had an effect on the people's behavior towards the disease. Of those who thought the programme had impacted positively on their behaviour towards the disease majority came from the Guinea Worm Freed Area of Dagomba land. Next in line were the Gonja and Nanumba areas, with the least representation coming from the Guinea Worm Freed Areas of Konkomba land. With respect to those who did not think the programme had an impact on their world view of the disease many of them came from the Guinea Worm Freed Areas of Dagomba land, followed by respondents from the Guinea Worm Freed Areas of Konkomba land and Nanumba land. Least among this category of respondents were those from Gonja land.

However, the Dagomba land was the only area which felt the programme cannot be credited with any positive or negative change in behaviour towards the disease. This was the opinion of 2.3% of respondents who indicated that paying attention to the environment was not part of the core mandate of the programme. So any activity of the programme which may have affected their environment should be considered as one of the residual effects of the programme. From the responses that were received it was observed the programme was thought to have brought not only attitudinal changes towards the use of surface sources of drinking water, but also changes in the vegetal cover of these areas. Figures 8.1 are a summary of the responses indicating people's changed behaviour towards the disease in the region.

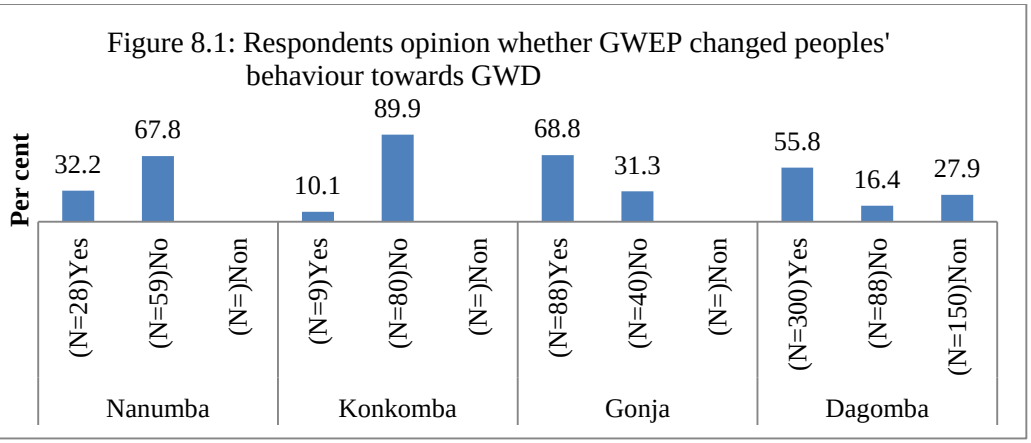


Figure 8.1: Respondents opinion whether GWEP changed peoples' behaviour towards GWD

Source: Field Data, September 2012 – January 2013

Table 8.1: Chi-square test on whether GWEP has changed peoples' behaviour towards GWD and the Environment

Variable	Value	df	Asymp. Sig
Respondent Category	1.458	1	.227
Age	28.629	5	.000
Gender	.194	1	.659
Education	8.636	4	.071
Occupation	222.113	3	.000
District	449.032	10	.000

Source: Field Data, 2012

With regard to whether the programme has changed people's behavior towards the disease and their environment it was found from Table 8.1 that at a significance level of 0.05 that the programme had changed peoples behaviour towards the disease with respect to age, occupation, and district because these variables had p-values less than 0.05.

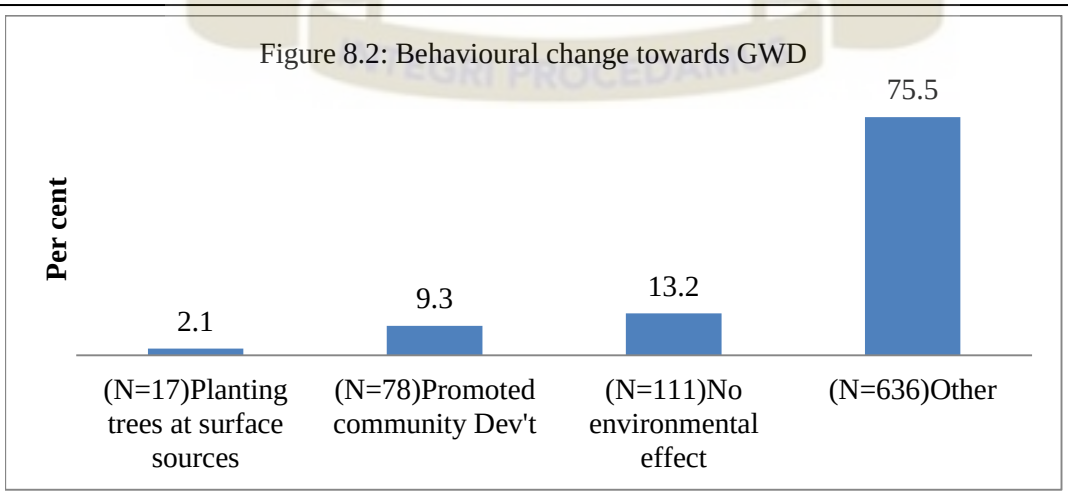


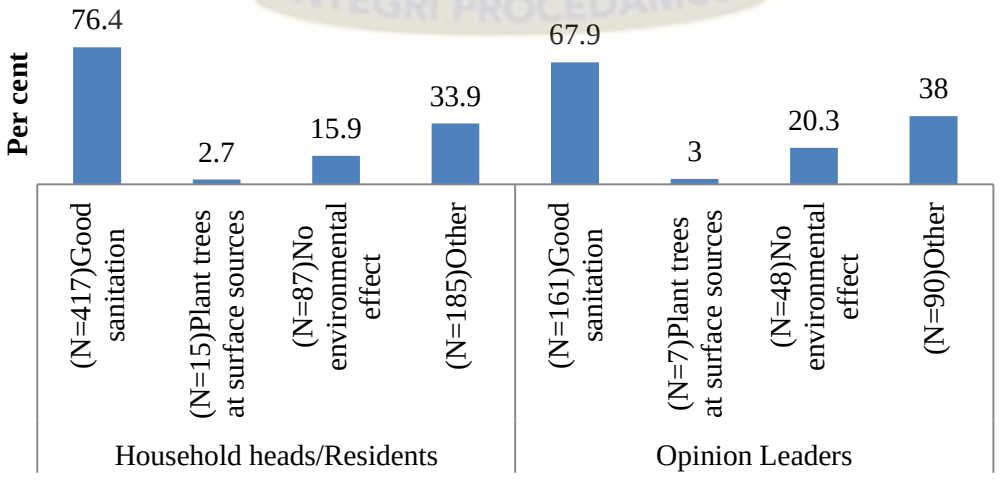
Figure 8.2: Behavioural change towards GWD

Source: Field Data, 2012

Respondents were then asked to advance reasons that made them think the programme has changed people's behaviour towards the disease. It came to light from Figure 8.2 that 2.1% of them indicated the programme made them observe the habit of planting trees at their surface sources of drinking water. Another 9% said the programme's activities paved the way for them to initiate community development projects. About 3% said inter-personal relations have been fostered among them. Another 13.2% said they did not think the programme has achieved any remarkable change in people's behaviour towards the disease or the environment. Also, 72% of respondents advanced no reason for the contribution of the programme in changing people's behavior towards the disease.

With regard to how the programme changed people's behaviour towards GWD by respondent category, Figure 8.3 revealed that most household heads/residents (76.4%) and approximately 68% of opinion leaders indicated the programme changed behaviour towards the disease by influencing them to adopt good sanitation practices. Some 20.3% opinion leaders and approximately 16 household heads/residents thought the programme has not influenced people to take good care of their surface sources of drinking water, while approximately 3% each of household heads and opinion leaders thought otherwise.

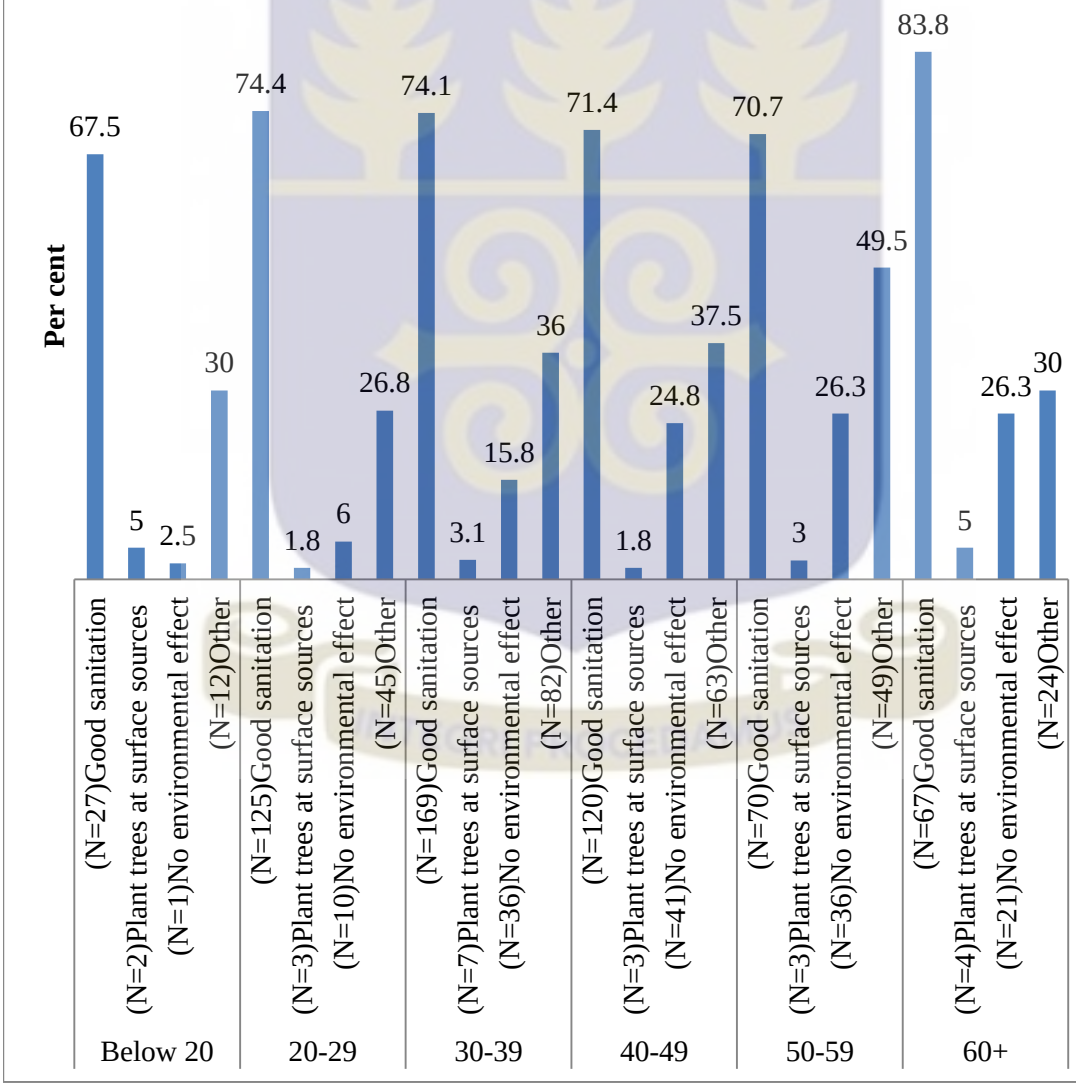
Figure 8.3: Behavioural change towards GWD by respondent category



Source: Field Data, 2012

When it came to the ways in which the programme changed people's behaviour towards the disease by age, Figure 8.4 showed respondents in all age groups with an average of 73.7% for each group were of the opinion that the programme influenced people to observe good sanitation practices. A sizeable portion from the 50 to over 60 years age group with each having 26.3% and 24% from the 40-49 age bracket were of the view that the programme has not influenced people to change their behaviour towards their surface sources of drinking water.

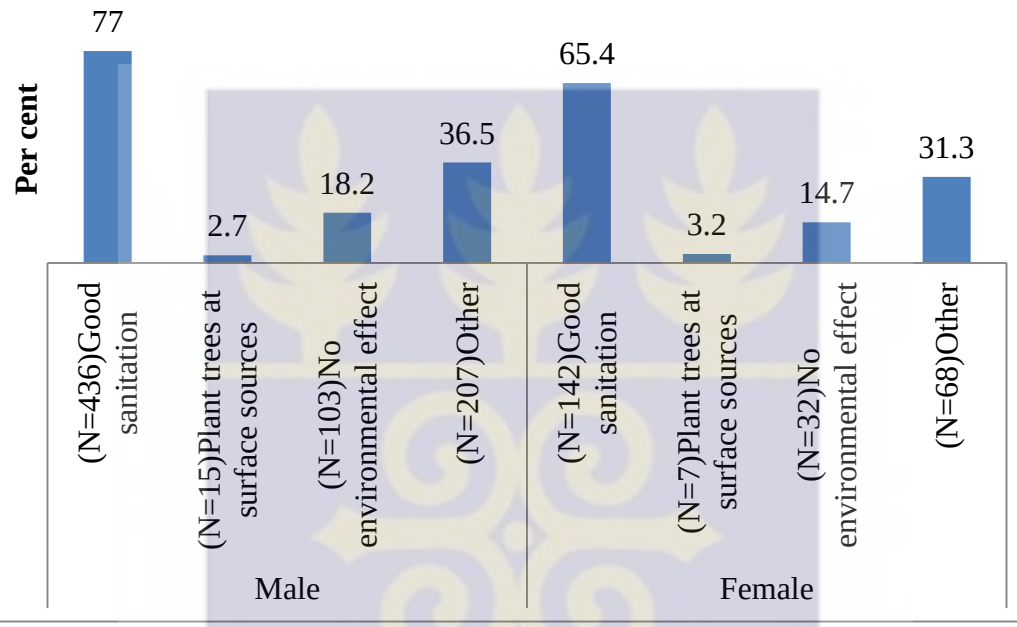
Figure 8.4: Behavioural change towards GWD by age



Source: Field Data, 2012

When behaviour towards the disease was cross tabulated by sex, Figure 8.5 revealed that most males (77%) and females (65.4%) indicated the programme influenced them to observe good sanitation. A sizeable number of males (18.2%) and females (14.7%) did not think the programme changed behaviour towards GWD and surface sources of drinking water.

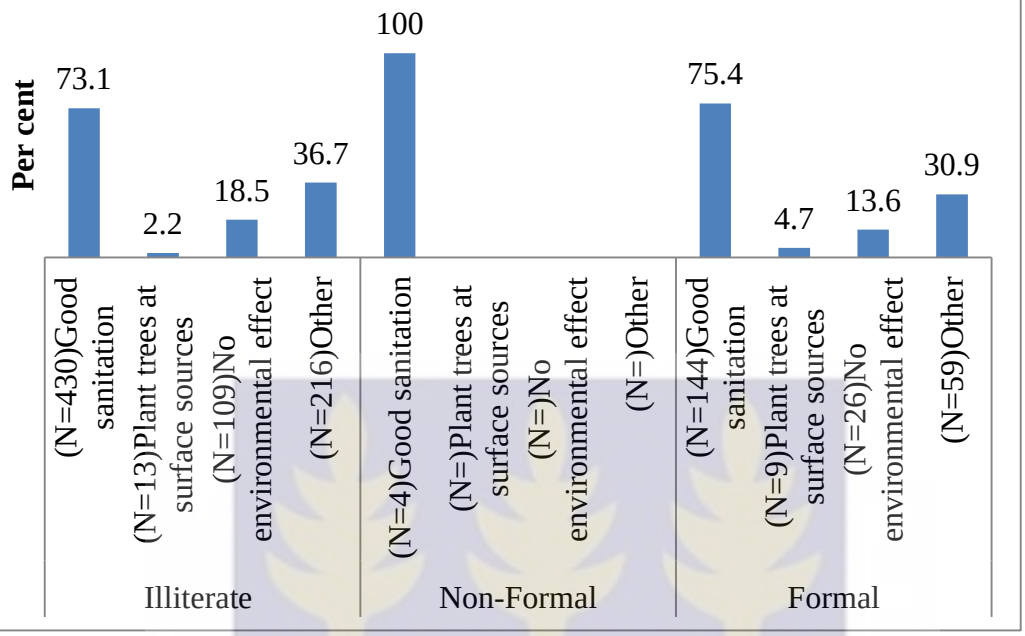
Figure 8.5: Behavioural change towards GWD by gender



Source: Field Data, 2012

When behaviour towards the disease was cross tabulated by education, Figure 8.6 indicated all respondents (100%) with non-formal education, 75.4% with formal education, and 73.1% illiterate were of the opinion the programme changed people's behaviour towards the disease by influencing them to observe good sanitation practices and protect their surface sources of drinking water. There was a contrary opinion in which approximately 19% illiterates and approximately 14% with formal education did not think the programme has changed people's behaviour towards GWD and surface sources of drinking water. There was a minority of approximately 5% with formal education and approximately 2% with no form of education indicating the programme influenced people to protect surface sources of drinking water.

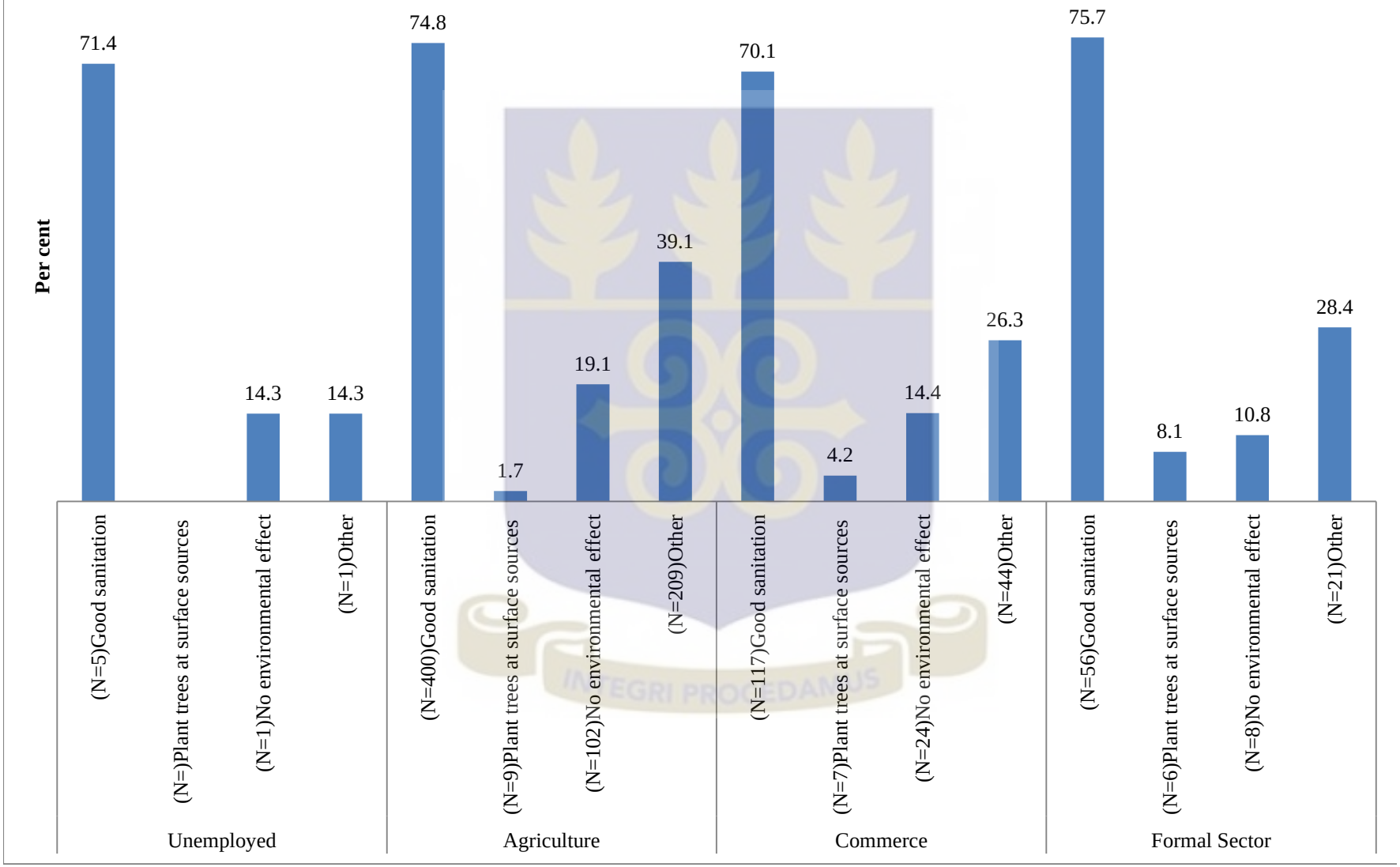
Figure 8.6: Behavioural changed towards GWD by education



Source: Field Data, 2012

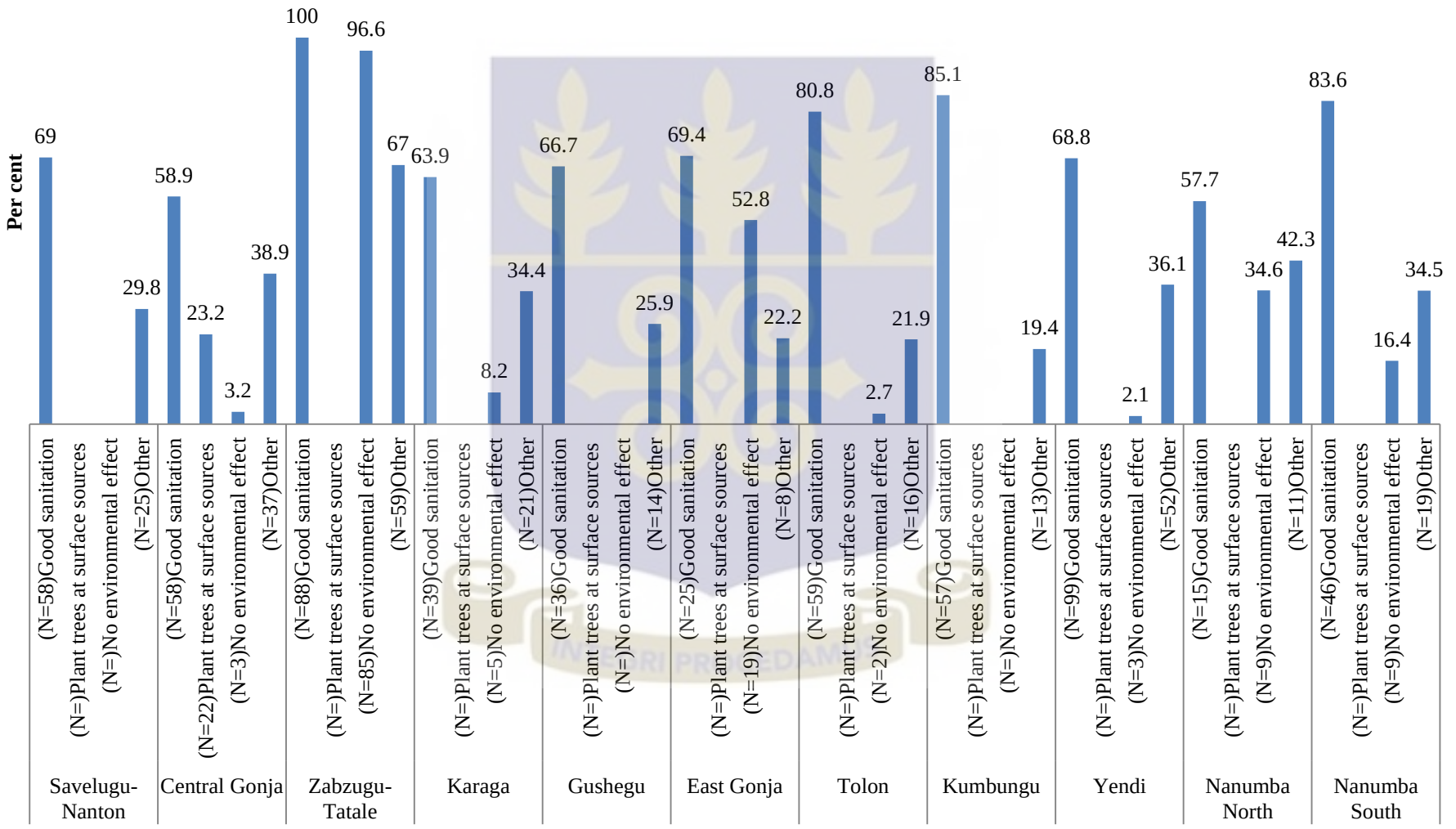
When occupation was cross tabulated with the ways in which respondents thought the programme changed people's behaviour towards the disease, Figure 8.7 indicated that most respondents from the formal sector (75.7%), agricultural sector (74.8%), the unemployed (71.4%) and commercial sector (70.1%) indicated that the programme changed people's behaviour towards the disease by influencing them to observe good sanitation practices by protecting their surface sources of drinking water. However, some 19% of respondents from the agric sector, 14% from the commercial sector and the unemployed, and approximately 11% from the formal sector indicated that the programme has not changed people's behaviour towards the disease and the environment from which the disease is contracted. Finally, those who thought the programme has influenced people to plant trees around surface sources of drinking water formed the minority in the formal sector (8.1%), commercial sector (4,2%), and the agric sector (1.7%).

Figure 8.7: Behavioural change towards GWD by occupation



Source: Field Data, 2012

Figure 8.8: Behavioural change towards GWD by district



Source: Field Data, 2012

When responses of the role the programme played in changing people's behaviour towards the disease were cross tabulated by district, it was found in Figure 8.8 that respondents from the following district, Zabzugu-Tatale (100%), Kumbungu (85.1%), Nanumba South (83.6%), Tolon (80.8%), East Gonja (69.4%), Savelugu-Nanton (69%), Yendi (68.8%), Gushegu (66.7%), Karaga (63.9%), Central Gonja (58.9%), and Nanumba North (57.7%), indicated that the programme has changed people's behaviour towards the disease by influencing them to observe good sanitation practices. Of respondents who were of the opinion that the programme has not changed people's attitude towards the disease and their surface sources of drinking water majority came from the East Gonja (52.8%), Nanumba North (34.6%), and Nanumba South (16.4%) district. Other respondents who subscribed to this view came from the Karaga, Central Gonja, Tolon, and Yendi districts. Lastly, the Central Gonja (23.2%) district was the only district which had respondents indicating that the programme changed people's behaviour towards the disease by encouraging them to plant trees at surface sources of drinking water.

Table 8.2: Chi-square test on GWEP's effect on behavioural change towards GWD

Variable	Value	df	Asymp. Sig
Respondent Category	686.152	650	.158
Age	3379.610	3250	.055
Gender	669.029	650	.294
Education	2624.1000	2600	.366
Occupation	2045.812	1950	.064
District	7291.835	6500	.000

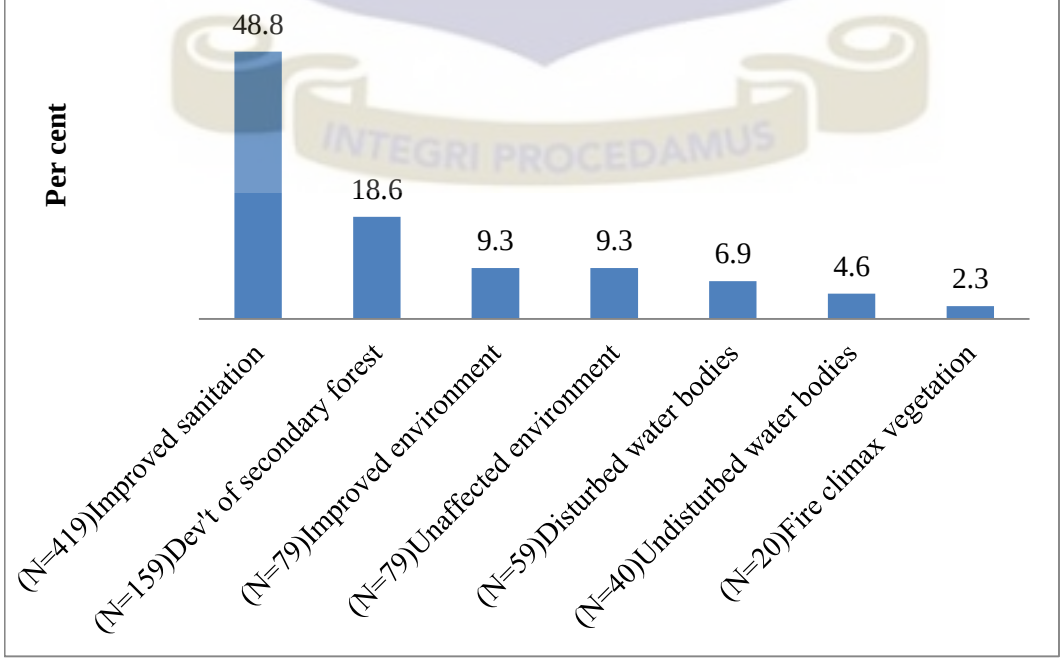
Source: Field Data, 2012

With regard to how the programme changed people's behaviour towards the disease with respect to respondent category, age, gender, education, occupation, and district, responses were subjected to Pearson's Chi square test to determine which of them are statistically related. At a significance level of 0.05 it was found in Table 8.2 above that the programme changed peoples' behaviour towards the disease with respect to district which had a p-value

which was less than 0.05, indicating change in people's behaviour towards the disease was significantly related to district.

It was found from the data that was gathered that the intervention measures which the GWEP introduced revolutionized the way people of the guinea worm endemic areas behaved towards the disease, which had an extended effect on their surrounding environment. They no longer saw the solution to their problem as a myth, but a reality they were capable of solving with the knowledge the programme had imparted to them. As a result of adhering to the intervention measures which the programme had encouraged them to adopt, respondents felt the intervention measures were solely or partially responsible for the following developments in their respective communities: improved sanitation –48.8%, development of secondary forest – 18.6%, improved environment and unaffected environment – 9.3% each, disturbed water bodies – 6.9%, undisturbed water bodies –4.7%, and the creation of fire climax vegetal cover 2.3%. These responses are shown in Figure 8.9 and the details of these responses are discussed below.

Figure 8.9: Effect of GWEP on the environment



Source: Field Data, September 2012 – January 2013

8.2.1 Behavioural change towards improved sanitation

The major effect on the environment which the GWEP is considered to have caused was in the area of improving sanitation (48.8%). In the opinion of this group the programme has had a positive effect on their environment. Volunteers were encouraged to influence community members to organise communal labour activities to clean up their surroundings. Households were also encouraged during the active presence of the programme to build household toilets and to practice the observance of personal hygiene. The innovation of creating stepping points at the edge of water bodies to avoid people coming into direct contact with water also contributed towards keeping the surrounding marine environment quite healthy. The following observations by respondents on the programme's contribution to improve sanitation in the former guinea worm endemic areas of the Northern Region are presented below to put forward an empathic illustration of respondents' views on the effect of the programme on the environment.`Forty eight year old Damu Mumuni (farmer and trader); 32 year old Yakubu Saibu; and the following unidentified responses respectively, had this to say on the effect of the programme had on people's behaviour towards their environment:

> "The way it (environment) used to be filthy when we were affected by the worm, it is no more like that";
>
> "Right now you can clean your compound and also clean around";
>
> "Communities ensure that the conditions at water fetching points are kept under hygienic conditions;" and,
>
> "Stepping points were created at dams and ponds. This kept sanitary conditions around water bodies in good condition."

Source: Extracts from FGD and Structured Questionnaire, Field Data, 2012

8.2.2 Behavioural change towards development of secondary forest

Some 18.6% of respondents indicated that the creation of secondary forests (Dickson and Benneh, 1988) around some of their water bodies was another effect that the GWEP had on the environment of the former guinea worm endemic areas of the region. The original climatic climax vegetal cover around water bodies were cut down and consumed by man and

livestock. The trees that currently exist around these water bodies are comparatively young. They are considered by Dickson and Benneh as the original trees which were destroyed by the work of man. They therefore describe this form of vegetal cover as secondary forest. This group of respondents reported that volunteers were tasked during the currency of the programme to take on board the additional responsibility of planting trees around water bodies. Volunteers therefore encouraged members of the former guinea worm endemic areas to plant trees along water bodies. This initiative by volunteers and their community members has resulted in the surrounding environment around some water bodies developing into relatively thick vegetation.

8.2.3 Behavioural change towards improved environment and unaffected environment

Another 18.6% of respondents further reported that the programme contributed towards improving their environment (9.3%), while the remaining 9.3% thought the programme did not have any effect on the environment. Those who thought the programme has improved their environment put up this view because they felt that they now have a healthy environment unlike before. During Focus Group Discussions that were conducted respondents from the Konkomba areas of Zabzugu-Tatale observed that the environment is still as good as it used to be before the programme started. The programme in their view has not done any harm to their environment. This is because the environment today looks better than before the programme was implemented. The accompanying comments by some respondents amply illustrate their perception of the programme's effect on the environment of the former guinea worm endemic areas of the Northern Region:

> "The environment here still favours us and, even better than before the introduction of the Guinea Worm Eradication Programme;" and,
> "It has improved upon the quality of our water bodies; our dams were regularly sprayed with chemicals."

Source: Extracts from FGD and Structured Questionnaire, Field Data, 2012

The other 9.3% who were of the opinion that the programme has not affected their environment advanced the following reasons to support their claim: a good environment still exist; there is no effect in relation to our environment; "we still enjoy our environment the way it used to be previously;" and, "no harm has been done to the environment since the introduction of the GWEP."

8.2.4 Behavioural change towards disturbed water bodies

There were some 7% of respondents who claimed the GWEP had the adverse effect of disturbing their water bodies by tacitly withdrawing the services of dam guards. This situation arose because the eradication of the disease is in sight, and safe sources of drinking water have been provided in most former guinea worm endemic areas in the region. Because of this situation a respondent in the Dagomba area said:

> "Our water bodies are being destroyed and polluted again because the dam guards are no more there."

Source: Extracts from FGD and Structured Questionnaire, Field Data, 2012

8.2.5 Behavioural change towards undisturbed water bodies

Some 4.7% of respondents, however, claimed that the programme did not disturb their surface sources of water supply as some respondents would want to have us believe. In the opinion of this group they think the surface sources of drinking water "are now well protected and regularly cleaned."

8.2.6 Behavioural change towards creation of fire climax vegetation

The remaining 2% of respondents commended the programme for helping in arresting the situation of critical areas of their vegetation being subjected to regular burning by bush fires, which created a fire climax vegetation (Dickson and Benneh, 1988), in some of the former guinea worm endemic areas of the Northern Region. Furthermore, the eradication of the disease has eliminated the problem of disability, thus making it possible for people to protect selected vegetation zones against indiscriminate burning. A respondent from the Dagomba

area of Kumbungu indirectly described the benefit the programme made against indiscriminate burning of bushes by saying:

> "Our forest reserves got burned and we could not stop it due to the guinea worm disease."

Source: Extracts from FGD and Structured Questionnaire, Field Data, 2012

This implies that with the eradication of the disease people are now healthy to take up various tasks including the protection of some parts of their forests. Plates 12 and 13 show the effect of the programme on peoples' changed behaviour towards their environment.

From the observed responses it was realised that the programme changed people's behaviour towards the disease and influenced guinea worm endemic communities to adopt life styles that transformed their reliance on surface sources of drinking water and, improved upon community sanitation and vegetal conditions which contributed in breaking the chain of transmission of the disease between the disease causing agent (physical environment and biological agent of the disease) and the human host.

Plate 9: Abandoned surface source of water supply (spring) and village volunteers, Nasamba, Nanumba South District

Source: Field Data, Janury, 2013

Plate13: Environmental effect of people's changed behaviour towards GWD

A – Continued dependence on surface sources of water supply

B – Abandoned surface source of water

C – Undisturbed water body and surrounding secondary forest vegetation

Source: Field Data, October – December, 2012

CHAPTER NINE

SUMMARY, CONCLUSION, RECOMMENDATIONS AND POLICY IMPLICATIONS

9.1 Summary

The findings of the research were summarized under the following themes: respondents' views of the GWEP, health, geological and cultural influences for the spread of the disease, socio-economic transformations the programme caused and the adoption of appropriate local technologies to treat surface water. It was found that the programme the disease and brought along with it health and socio-economic benefits. Recommendations were made to influence policy with respect to the provision of potable water in areas that are vulnerable to guinea worm infection.

9.1.1 Respondents views on the guinea worm epidemic

It was found that majority of respondents interviewed (17.1%) came from the Yendi District. The Nanumba North District had the least number of respondents. With regard to respondent category majority (69%) were household heads. In addition, majority (29.3%) of those interviewed for the entire study area were between 30 and 39 years, and most (71%) were male. With respect to education majority (75.6%) were illiterate. Most respondents (68.1%) were farmers.

It was found that respondents attributed (77.7%) poor access to potable water as the major cause of the disease. Majority (65.6%) indicated the epidemic made people unable to work. Majority (55.9%) were of the opinion that the health situation during the epidemic was very bad. Chi-square test of respondents' knowledge of the cause of the disease showed that most respondents had sufficient knowledge of the cause of the disease. Chi-square test of their opinion of the health situation during the epidemic indicated that the health situation was very bad.

9.1.2 Respondents views on the GWEP

With regard to the operations of the GWEP, it was found that most respondents indicated it provided them with cloth filters (67.2%). Respondents indicated that the provision of potable water and intervention measures were responsible for the eradication of the disease. It was found majority (99.2%) of respondents were of the opinion that the programme has improved their economic wellbeing. With regard to whether the programme has improved their social wellbeing 99.9% of respondents indicated the programme has improved their social wellbeing.

Chi-square tests of the programme's activities showed that people's behaviour towards the disease and their environment was significantly influenced at the district level of intervention. Chi-square tests of the programme's effect on health was significantly influenced at the district level of intervention. Chi-square tests on the programme's effect on economic wellbeing showed that the programme significantly contributed towards improving economic wellbeing at the district level of intervention. With regard to the programme improving social wellbeing that programme improved social wellbeing at the district level of intervention. With regard to the programme changing people's behaviour towards the disease and their environment it was found that programme played a significant role in changing people's behaviour towards the disease and their environment by age, occupation, and district

9.1.3 Geological and cultural influences

It was found that culture of some ethnic groups was a factor which accounted for the presence or absence of the disease. The major cultural practice that influenced the spread of the disease was the "knee deep" practice of fetching water from surface sources of drinking water and the belief that water from surface sources tasted better than underground water. There was

another cultural practice of avoiding human contact with surface sources of drinking water. This practice insulated people from running the risk of catching disease.

9.1.4 Health

The programme positive effects on the health needs of communities. It was found that the programme broadened people's knowledge of the disease. It was observed during the fieldwork that community members readily showed interest on the subject. This, Dr Sam Bugri – Chairman of the 13 member National Guinea Worm Certification Committee – indicated was one of the major uncosted benefits which the programme realized during its operations and inured to the benefit of other activities related to the fight against the disease. He described this benefit as a real social mobilization strategy that gave staff of the programme good recognition in the conflict zones of the region, by granting them unimpeded access into these areas.

9.1.5 Socio-economic transformations during the GWEP

It was found that the progrmme played a positive role in improving the social and economic wellbeing by freeing them of the disease and making it possible for them to engage productive employment. Another socio-economic transformation that emerged as a result of the programme's collaborative influence was the shift towards using mechanized boreholes. There are several communities which are yet to benefit from such a facility. However, some respondents' indicated the programme did not bring along with it anticipated socio-economic intervention which would benefit them. It was expected the programme would canvass for national and global support to channel resources to develop rural agricultural livelihoods after the disease has been eradicated.

9.1.6 Behavioural change towards GWD and the environment

It was found that community members changed their behaviour towards the disease by making them take precautionary measures when fetching water from surface sources. This has made surface sources and the vegetation around them to revert to their near original state.

9.2 Conclusion

To conclude, political commitment to eradicate the disease was found to be the major factor responsible for the programme's success**.** Ghana's effort to eradicate the disease coupled with global cooperation, met the challenge of eradicating the disease by making it a priority issue in the country's national development agenda.

The programme has changed the health and sanitation dynamics of communities that were affected by the disease. The programme over its 22 year period of operation was able to reduce the number of cases of guinea worm to zero and increase the productivity of labour which has translated into an improvement in the standard of living of people. The transfer of domestic responsibilities like infant and maternal child care, and keeping the domestic environment clean as a result of guinea worm infection, to other relatives has also become a thing of the past. It is expected that the current situation of eradicating the disease has resulted in an overall improvement of child attendance at school. Difficulties encountered in catering for children and personal hygiene of households, and entire communities are no longer attributed to the disease.

Other conclusions were that the programme transformed the socio-economic wellbeing and cultural life of people in affected communities, and changed their behaviour towards the disease and their environment, with there being the need to further develop appropriate local technologies of purifying surface sources of drinking water at the rural level. It is expected that during this period of precertification surveillance the disease will no more be cited as one of the causal factors of food shortage during the lean season. Respondents' attested to the fact that the eradication of the disease has improved productivity of labour and increased crop yield and incomes of households.

9.3 Recommendations and Policy Implications

Having succeeded in bringing the number of cases of guinea worm infections to zero, it is appropriate to pursue policies that will forever keep the re-occurrence of the disease permanently out of sight. To achieve this objective the following recommendations were made:

i. The activities of the secretariat of the GWEP should continue to ensure that the educational and social safety nets that contributed to ensure the programme's success are not allowed to collapse.

ii. The Government of Ghana should work at sustaining the supply of funds, resources and technical support to the quasi presence of the GWEP after Ghana has been certified to be free of the disease.

iii. There should be scientific experiments and training programmes at the community level of the programme to ensure that potable water supply facilities are not allowed to break down.

iv. In furtherance of the Government's role to keep the supply of funds and resources to the programme going, the Government should adopt innovative ways of persuading the private manufacturing sector to produce local water purification equipment an sold at subsidized prices to households. The Government of Ghana should pursue this recommendation by making it a joint collaborative effort between the re-branded form of the GWEP, the CWSA and the private manufacturing sector.

v. The re-branded form of the GWEP in collaboration with the CWSA should develop a community checklist of safe sources of drinking water for the entire country. This list could be used as a guide to ensure that the elimination of unsafe sources of drinking water in the country becomes a reality and not a myth.

vi. The programme succeeded in sensitizing people to adopt practices that would eliminate their risk of being infected with the disease. Now, is the time to educate people to acquire the habit of carrying enough potable water when going afield.

Programmes aimed at showing cinemas about rural areas in other parts of the world carrying potable water supplies from their homes when going afield to engage in their economic activities should be organized. The practice of wearing protective clothing (wellington boots) when visiting surface sources of drinking water and when going afield should be presented as a way of life which must be adopted.

vii. The Government of Ghana should make generous budgetary allocations to the proposed second phase of the re-branded form of the GWEP to enable it carry out research on its achievements; and, by so doing prepare the country to take up the challenge of going further to eradicate another of the six communicable diseases.

The recommendations that have been made are expected to have the following implication for policy. The major policy question that arises is "what form should the proposed second phase of the re-branded form of the programme assume in Ghana's attempt to ensure that guinea worm as a disease never makes an appearance in Ghana's health records and medical and historical geography?"

If Ghana records no case of guinea worm infection during its period of precertification surveillance, it will be prudent to put in place consolidation measures to achieve the objective of transforming rural livelihoods by adopting simple appropriate local technologies of purifying large quantities of surface water at the community household level at all times. This can be done by using large receptales like our local iron pots as water treatment jars in which large quantities of water can be filtered, purified with alum and chlorine, and lastly boiled to render other microorganisms ineffective before preserving it.

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APPENDIX I

HHHQ S/N.....

DEPARTMENT OF GEOGRAPHY AND RESOURCE DEVELOPMENT

UNIVERSITY OF GHANA

LEGON

THESES QUESTIONNAIRE

TOPIC: AN ANALYSIS OF THE GUINEA WORM ERADICATION PROGRAMME AND ITS EFFECTS ON SOCIAL AND ECONOMIC DEVELOPMENT IN THE NORTHERN REGION OF GHANA

DISTRICT.....

HOUSEHOLD HEADS AND RESIDENTS OTHER THAN HOUSEHOLD HEADS

1. Age
2. Sex
3. Education
4. Occupation
5. Can you describe the various ways in which the guinea worm epidemic affected the people in this community?
6. What was the health situation in this area like before the Guinea Worm Eradication Programme was implemented?
7. Do you think the Guinea Worm Eradication Programme has improved the condition of health of the people of this community?
8. In what ways would you say the Guinea Worm Eradication Programme has contributed the health of the people of this community?
9. Do you think the Guinea Worm Eradication Programme has improved the social well being of the people of this community?
10. In what ways do you think the Guinea Worm Eradication Programme has affected the social well being of the people of this community?
11. Do you think the Guinea Worm Eradication Programme has improved the economic well being of the people of this community?
12. In what ways do you think the Guinea Worm Eradication Programme has improved the economic well being of the people of this community?
13. Do you think the Guinea Worm Eradication Programme has affected the environment of the people of this community?

14. In what ways do you think the Guinea Worm Eradication Programme has affected the environment of this community?

TEST OF HYPOTHESES

15. What do you think was responsible for the prevalence of guinea worm cases in this community?
16. What do you think was responsible for the reduction in the number of guinea worm cases in this community?

DEPARTMENT OF GEOGRAPHY AND RESOURCE DEVELOPMENT

UNIVERSITY OF GHANA

LEGON

THESES QUESTIONNAIRE

HYPOTHESIS TEST

TOPIC: AN ANALYSIS OF THE GUINEA WORM ERADICATION PROGRAMME AND ITS EFFECTS ON SOCIAL AND ECONOMIC DEVELOPMENT IN THE NORTHERN REGION OF GHANA

1. Age
2. Sex
3. Education
4. Occupation
5. Ho: What do you think was responsible for the prevalence of guinea worm cases in this community?

   (i) Sources of water supply.....

   (ii) Ignorance/Lack of knowledge.....

   (iii) Spiritual causes.....

   (iv) Sanitation.....

   (v) Imported.....

6. H1: What do you think was responsible for the reduction in the number of guinea worm cases in this community?

   (i) Intervention measures.....

   (ii)

   (iii) Sources of water supply.....

(iv) Acquired knowledge on the disease.....

(v) Sanitation.....

(vi) Community cooperation with GWEP..... .....

KIIQ S/N.....

DEPARTMENT OF GEOGRAPHY AND RESOURCE DEVELOPMENT

UNIVERSITY OF GHANA

LEGON

THESES QUESTIONNAIRE

TOPIC: AN ANALYSIS OF THE GUINEA WORM ERADICATION PROGRAMME AND ITS EFFECTS ON SOCIAL AND ECONOMIC DEVELOPMENT IN THE NORTHERN REGION OF GHANA

DISTRICT.....

OPINION LEADERS

1. Age
2. Sex
3. Education
4. Occupation
5. Can you describe the various ways in which the guinea worm epidemic affected the people in this community
6. What was the health situation in this area like before the Guinea Worm Eradication Programme was implemented?
7. How did the Guinea Worm Eradication Programme carry out its operations in the Northern Region of Ghana
8. Do you think the Guinea Worm Eradication Programme has improved the condition of health of the people of this community?
9. In what ways would you say the Guinea Worm Eradication Programme has contributed the health of the people of this community?
10. Do you think the Guinea Worm Eradication Programme has improved the social well being of the people of this community?

11. In what ways do you think the Guinea Worm Eradication Programme has affected the social well being of the people of this community?
12. Do you think the Guinea Worm Eradication Programme has improved the economic well being of the people of this community?
13. In what ways do you think the Guinea Worm Eradication Programme has improved the economic well being of the people of this community?
14. Do you think the Guinea Worm Eradication Programme has affected the environment of the people of this community?
15. In what ways do you think the Guinea Worm Eradication Programme has affected the environment of this community?

TEST OF HYPOTHESES

16. What do you think was responsible for the prevalence of guinea worm cases in this community?
17. What do you think was responsible for the reduction in the number of guinea worm cases in this community?

FGDQ S/N.....

DEPARTMENT OF GEOGRAPHY AND RESOURCE DEVELOPMENT

UNIVERSITY OF GHANA

LEGON

THESES QUESTIONNAIRE

TOPIC: AN ANALYSIS OF THE GUINEA WORM ERADICATION PROGRAMME AND ITS EFFECTS ON SOCIAL AND ECONOMIC DEVELOPMENT IN THE NORTHERN REGION OF GHANA

DISTRICT.....

FOCUS GROUP DISCUSSION

1. Can you describe the various ways in which the guinea worm epidemic affected the people in this community.
2. What was the health situation in this area like before the Guinea Worm Eradication Programme was implemented?

3. Describe the effectiveness of the Guinea Worm Eradication Programme in this community
4. In what ways would you say the Guinea Worm Eradication Programme has contributed the health of the people of this community?
5. In what ways do you think the Guinea Worm Eradication Programme has affected the social well being of the people of this community?
6. In what ways do you think the Guinea Worm Eradication Programme has improved the economic well being of the people of this community?
7. In what ways do you think the Guinea Worm Eradication Programme has affected the environment of this community?
8. What should be done to the guinea worm eradication programme now that Ghana is about to be declared to be free of guinea worm infection

GWEPTQ.....

DEPARTMENT OF GEOGRAPHY AND RESOURCE DEVELOPMENT

UNIVERSITY OF GHANA

LEGON

THESES QUESTIONNAIRE

TOPIC: AN ANALYSIS OF THE GUINEA WORM ERADICATION PROGRAMME AND ITS EFFECTS ON SOCIAL AND ECONOMIC DEVELOPMENT IN THE NORTHERN REGION OF GHANA

DISTRICT.....

GWEP STAFF AND OTHER TECHNOCRATS

1. Age
2. Sex
3. Education
4. Occupation
5. What does the future hold for the Guinea Worm Eradication Programme and its staff now that the programme is on the verge of certifying Ghana as being free of guinea worm infection?
6. What has been the programme's major contribution to health and socioeconomic development in Ghana?
7. What do you think has been Ghana's major contribution in the Guinea Worm Eradication Programme in the global effort to eradicate guinea worm?

8. Can you recall some of the landmark events that prevailed in Ghana at the sectorial and institutional level that culminated in the implementation of the Guinea Worm Eradication Programme?
9. What was the responsibility of the Guinea Worm Eradication Programme at the community level of health care delivery?
10. What was the responsibility of the Guinea Worm Eradication Programme at the district level of health care delivery?
11. What was the responsibility of the Guinea Worm Eradication at the sectoral level of health care delivery?

APPENDIX II

OUTPUT OF ANALYSIS

CHI-SQUARE

	Value	df	Asymp. Sig. (2-sided)
ages of respondents * can you describe the various ways in which guinea epidemic affected the people in this community			
Pearson Chi-Square	3906.576[a]	3850	.258
ages of respondents * how did GWEP carry out its operation in the northern region of Ghana			
Pearson Chi-Square	1269.145[a]	1240	.276
ages of respondents * in what ways would you say GWEP has contributed the health of the people of this community			
Pearson Chi-Square	3976.767[a]	3975	.489
ages of respondents * do you think GWEP has improved the social wellbeing of the people of this community			
Pearson Chi-Square	3.782[a]	5	.581
ages of respondents * in what ways do you think GWEP has affected the social well being of the people of this community			
Pearson Chi-Square	4040.494[a]	3960	.182
ages of respondents * do you think the GWEP has improved the economic well being of the people of this community			
Pearson Chi-Square	4.208[a]	5	.520
ages of respondents * in what ways do you think GWEP has improved the economic well being of the people of this community			
Pearson Chi-Square	4088.746[a]	4050	.331
ages of respondents * do you think the GWEP has affected the environment of the people of this community			
Pearson Chi-Square	28.629[a]	5	.000
ages of respondents * in what ways do you think GWEP has affected the environment of this community			
Pearson Chi-Square	3379.610[a]	3250	.055
ages of respondents * what do you think was responsible for the prevalence Guinea Worm cases in this community			
Pearson Chi-Square	2540.871[a]	2390	.016
ages of respondents * what do you think was responsible for the reduction in the number of Guinea Worm cases in this community			
Pearson Chi-Square	3552.141[a]	3480	.193

	Value	df	Asymp. Sig. (2-sided)	
district * can you describe the various ways in which guinea epidemic affected the people in this community				
Pearson Chi-Square	8371.850[a]	7700	.000	
district * what was the health situation in this area like before GWEP was implemented				
Pearson Chi-Square	6749.553[a]	5720	.000	
district * how did GWEP carry out its operation in the northern region of Ghana				
Pearson Chi-	2114.467[a]	1984	.021	

Square				
district * do you think GWEP has improved the condition of health of the people of this community				
district * in what ways would you say GWEP has contributed the health of the people of this community				
Pearson Chi-Square	8325.913[a]	7950	.002	
district * do you think GWEP has improved the social wellbeing of the people of this community				
Pearson Chi-Square	9.628[a]	10	.474	
district * in what ways do you think GWEP has affected the social well being of the people of this community				
Pearson Chi-Square	8377.897[a]	7920	.000	
district * do you think the GWEP has improved the economic well being of the people of this community				
Pearson Chi-Square	18.897[a]	10	.042	
district * in what ways do you think GWEP has improved the economic well being of the people of this community				
Pearson Chi-Square	8461.404[a]	8100	.003	
district * do you think the GWEP has affected the environment of the people of this community				
Pearson Chi-Square	449.032[a]	10	.000	
district * in what ways do you think GWEP has affected the environment of this community				
Pearson Chi-Square	7291.835[a]	6500	.000	
district * what do you think was responsible for the prevalence Guinea Worm cases in this community				
Pearson Chi-Square	6799.063[a]	4780	.000	
district * what do you think was responsible for the reduction in the number of Guinea Worm cases in this community				
Pearson Chi-Square	7963.728[a]	6960	.000	
	Value	df	Asymp. Sig. (2-sided)	
education * can you describe the various ways in which guinea epidemic affected the people in this community				
Pearson Chi-Square	1639.720[a]	1540	.038	
education * what was the health situation in this area like before GWEP was implemented				
Pearson Chi-Square	879.294[a]	1144	1.000	
education * how did GWEP carry out its operation in the northern region of Ghana				
Pearson Chi-Square	254.206[a]	248	.380	
education * do you think GWEP has improved the condition of health of the people of this community				
Pearson Chi-	.[a]			

Square				
education * in what ways would you say GWEP has contributed the health of the people of this community				
Pearson Chi-Square	1514.236[a]	1590	.912	
education * do you think GWEP has improved the social wellbeing of the people of this community				
Pearson Chi-Square	.323[a]	2	.851	
education * in what ways do you think GWEP has affected the social well being of the people of this community				
Pearson Chi-Square	1479.231[a]	1584	.971	
education * do you think the GWEP has improved the economic well being of the people of this community				
Pearson Chi-Square	2.280[a]	2	.320	
education * in what ways do you think GWEP has improved the economic well being of the people of this community				
Pearson Chi-Square	1397.522[a]	1620	1.000	

	Value	df	Asymp. Sig. (2-sided)
occupation * can you describe the various ways in which guinea epidemic affected the people in this community			
Pearson Chi-Square	2193.877[a]	2310	.958
occupation * what was the health situation in this area like before GWEP was implemented			
Pearson Chi-Square	1743.683[a]	1716	.315
occupation * how did GWEP carry out its operation in the northern region of Ghana			
Pearson Chi-Square	789.566[a]	744	.120
occupation * do you think GWEP has improved the condition of health of the people of this community			
occupation * in what ways would you say GWEP has contributed the health of the people of this community			
Pearson Chi-Square	2368.364[a]	2385	.592
occupation * do you think GWEP has improved the social wellbeing of the people of this community			
Pearson Chi-Square	.468[a]	3	.926
occupation * in what ways do you think GWEP has affected the social well being of the people of this community			
Pearson Chi-Square	2443.352[a]	2376	.164
occupation * do you think the GWEP has improved the economic well being of the people of this community			
Pearson Chi-Square	1.214[a]	3	.750
occupation * in what ways do you think GWEP has improved the economic well being of the people of this community			
Pearson Chi-Square	2519.426[a]	2430	.101
occupation * do you think the GWEP has affected the environment of the people of this community			
Pearson Chi-Square	22.113[a]	3	.000

occupation * in what ways do you think GWEP has affected the environment of this community			
Pearson Chi-Square	2045.812[a]	1950	.064
occupation * what do you think was responsible for the prevalence Guinea Worm cases in this community			
Pearson Chi-Square	1691.715[a]	1434	.000
occupation * what do you think was responsible for the reduction in the number of Guinea Worm cases in this community			
Pearson Chi-Square	2161.165[a]	2088	.129
	Value	df	Asymp. Sig. (2-sided)
respondents category * can you describe the various ways in which guinea epidemic affected the people in this community			
Pearson Chi-Square	823.256[a]	770	.089
respondents category * what was the health situation in this area like before GWEP was implemented			
Pearson Chi-Square	653.356[a]	572	.010
respondents category * how did GWEP carry out its operation in the northern region of Ghana			
Pearson Chi-Square	239.207[a]	248	.644
respondents category * do you think GWEP has improved the condition of health of the people of this community			
Pearson Chi-Square	.[a]		
respondents category * in what ways would you say GWEP has contributed the health of the people of this community			
Pearson Chi-Square	813.754[a]	795	.314
respondents category * do you think GWEP has improved the social wellbeing of the people of this community			
Pearson Chi-Square	2.236[a]	1	.135
respondents category * in what ways do you think GWEP has affected the social well being of the people of this community			
Pearson Chi-Square	830.683[a]	792	.165
respondents category * do you think the GWEP has improved the economic well being of the people of this community			
Pearson Chi-Square	2.270[a]	1	.132
respondents category * in what ways do you think GWEP has improved the economic well being of the people of this community			
Pearson Chi-Square	845.534[a]	810	.188
respondents category * do you think the GWEP has affected the environment of the people of this community			
Pearson Chi-Square	1.458[a]	1	.227
respondents category * in what ways do you think GWEP has affected the environment of this community			
Pearson Chi-Square	686.152[a]	650	.158
respondents category * what do you think was responsible for the prevalence Guinea Worm cases in this community			
Pearson Chi-Square	574.832[a]	478	.002
respondents category * what do you think was responsible for the reduction in the number of Guinea Worm cases in this community			
Pearson Chi-Square	774.290[a]	696	.021

	Value	df	Asymp. Sig. (2-sided)
sex * can you describe the various ways in which guinea epidemic affected the people in this community			
Pearson Chi-Square	807.275[a]	770	.171
sex * what was the health situation in this area like before GWEP was implemented			
Pearson Chi-Square	593.023[a]	572	.263
sex * how did GWEP carry out its operation in the northern region of Ghana			
Pearson Chi-Square	252.424[a]	248	.410
sex * do you think GWEP has improved the condition of health of the people of this community			
sex * in what ways would you say GWEP has contributed the health of the people of this community			
Pearson Chi-Square	794.702[a]	795	.496
sex * do you think GWEP has improved the social wellbeing of the people of this community			
Pearson Chi-Square	2.485[a]	1	.115
sex * in what ways do you think GWEP has affected the social well being of the people of this community			
Pearson Chi-Square	798.273[a]	792	.431
sex * do you think the GWEP has improved the economic well being of the people of this community			
Pearson Chi-Square	.689[a]	1	.407
sex * in what ways do you think GWEP has improved the economic well being of the people of this community			
Pearson Chi-Square	836.049[a]	810	.256
sex * do you think the GWEP has affected the environment of the people of this community			
Pearson Chi-Square	.194[a]	1	.659
sex * in what ways do you think GWEP has affected the environment of this community			
Pearson Chi-Square	669.029[a]	650	.294
sex * what do you think was responsible for the prevalence Guinea Worm cases in this community			
Pearson Chi-Square	515.095[a]	478	.117
sex * what do you think was responsible for the reduction in the number of Guinea Worm cases in this community			
Pearson Chi-Square	737.906[a]	696	.132

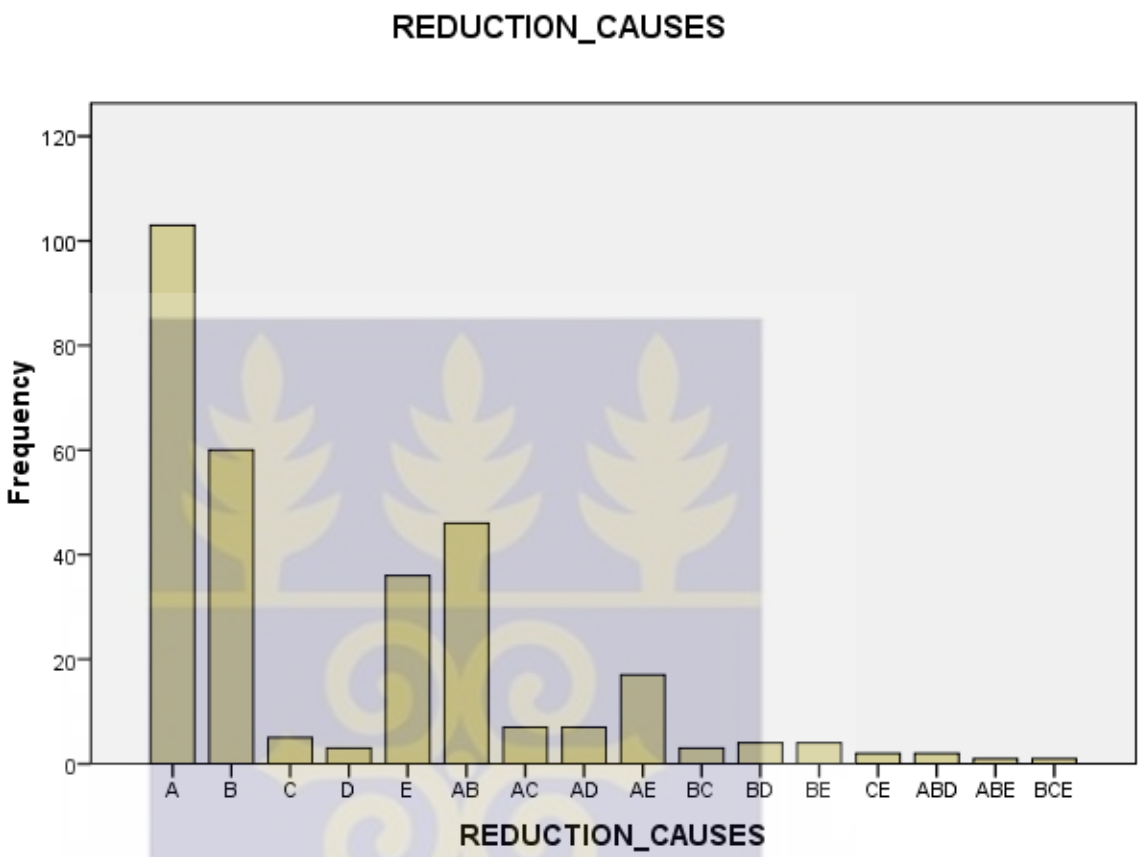
ANALYSIS FOR HPOTHESIS TEST

Table 1: Frequencies of the various causes responsible for the reduction in the number of guinea worm cases in the communities

REDUCTION_CAUSES

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	A	103	34.2	34.2	34.2
	B	60	19.9	19.9	54.2
	C	5	1.7	1.7	55.8
	D	3	1.0	1.0	56.8
	E	36	12.0	12.0	68.8
	AB	46	15.3	15.3	84.1
	AC	7	2.3	2.3	86.4
	AD	7	2.3	2.3	88.7
	AE	17	5.6	5.6	94.4
	BC	3	1.0	1.0	95.3
	BD	4	1.3	1.3	96.7
	BE	4	1.3	1.3	98.0
	CE	2	.7	.7	98.7
	ABD	2	.7	.7	99.3
	ABE	1	.3	.3	99.7
	BCE	1	.3	.3	100.0
	Total	301	100.0	100.0	

Table 2: A Bar chart showing the frequencies of causes responsible for the reduction in the number of guinea worm the communities.



A Chi-square test at 5% significance level to find out among the causes given by the community members, which one of them is more responsible for the reduction in the number of guinea worm cases in the Northern region.

H_0: The frequencies observed do not differ from the expected.

H1: There is a difference between the observed and expected frequencies.

REDUCTION_CAUSES

	Observed N	Expected N	Residual
A	103	18.8	84.2
B	60	18.8	41.2
C	5	18.8	-13.8
D	3	18.8	-15.8
E	36	18.8	17.2
AB	46	18.8	27.2
AC	7	18.8	-11.8
AD	7	18.8	-11.8
AE	17	18.8	-1.8
BC	3	18.8	-15.8
BD	4	18.8	-14.8
BE	4	18.8	-14.8
CE	2	18.8	-16.8
ABD	2	18.8	-16.8
ABE	1	18.8	-17.8
BCE	1	18.8	-17.8
Total	301		

Chi-Square Test

Test Statistics

	REDUCTION_CAUSES
Chi-Square	660.754[a]
df	15
Asymp. Sig.	.000

The null hypothesis was rejected in favour of the alternative hypothesis since the p-value=0.000 is less than 0.05. Therefore it was concluded that among the reasons stated, intervention measures was considered more responsible for the reduction in number of cases of guinea worm infections in the Northern region.

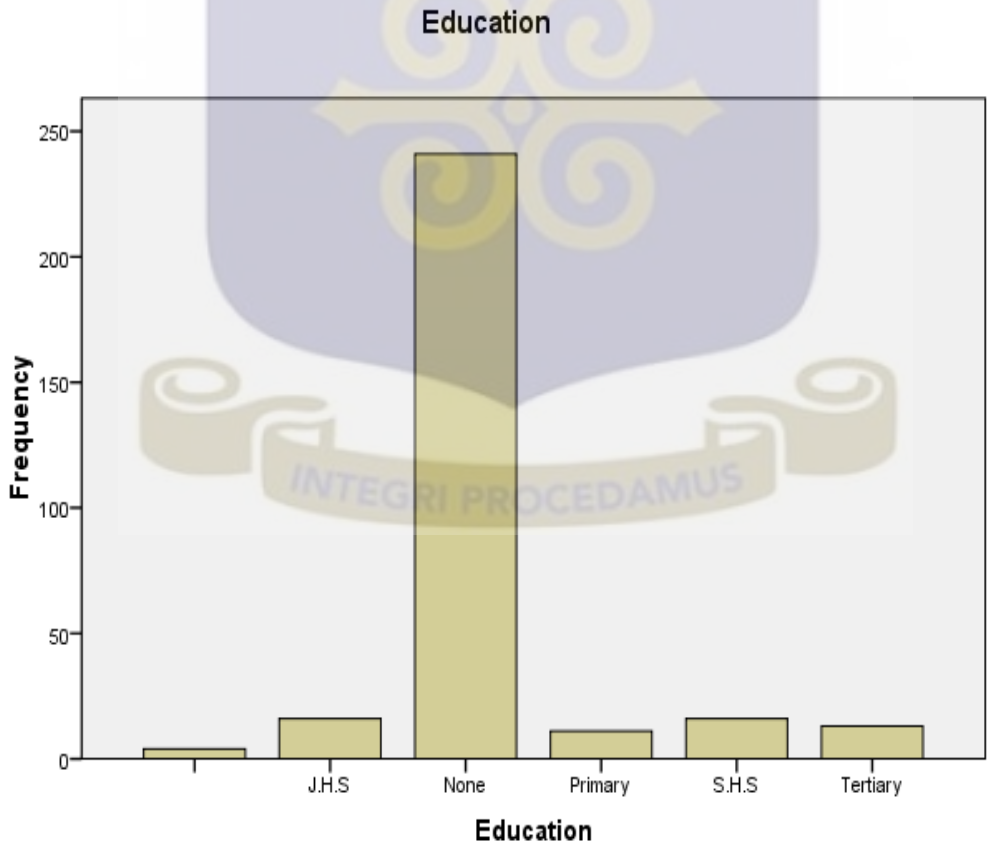
Frequency Tables and Bar Charts

Sex

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid		5	1.7	1.7	1.7
	Female	85	28.2	28.2	29.9
	Male	211	70.1	70.1	100.0
	Total	301	100.0	100.0	

Education

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid		4	1.3	1.3	1.3
	J.H.S	16	5.3	5.3	6.6
	None	241	80.1	80.1	86.7
	Primary	11	3.7	3.7	90.4
	S.H.S	16	5.3	5.3	95.7
	Tertiary	13	4.3	4.3	100.0
	Total	301	100.0	100.0	



Occupation

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid		5	1.7	1.7	1.7
	Apprentice	7	2.3	2.3	4.0
	Blacksmith	1	.3	.3	4.3
	Butcher	3	1.0	1.0	5.3
	Carpentary	1	.3	.3	5.6
	CHIO	1	.3	.3	6.0
	Driver	3	1.0	1.0	7.0
	Facilator CPYWD	1	.3	.3	7.3
	Farming	186	61.8	61.8	69.1
	Farming and Shoeshine	1	.3	.3	69.4
	Food Vendor	3	1.0	1.0	70.4
	Herdsman	1	.3	.3	70.8
	Housewife	6	2.0	2.0	72.8
	Kenkey seller	1	.3	.3	73.1
	Mason	1	.3	.3	73.4
	National Service Personel	1	.3	.3	73.8
	Nurse	2	.7	.7	74.4
	Seamstress	1	.3	.3	74.8
	Self employed	1	.3	.3	75.1
	Shea butter and Trading	1	.3	.3	75.4
	Shea butter production	3	1.0	1.0	76.4
	Student	17	5.6	5.6	82.1
	Student and Butcher	1	.3	.3	82.4
	Teaching	9	3.0	3.0	85.4
	Trading	32	10.6	10.6	96.0
	Trading and Farming	7	2.3	2.3	98.3
	Trading and Trading	1	.3	.3	98.7
	Unemployed	4	1.3	1.3	100.0
	Total	301	100.0	100.0