

## **FULL LENGTH RESEARCH**

# **Population Size and Health Implications of Large-Scale Mining at Bibiani-Ahwiaso Bekwai District: A Comparative Study in Akoti (Mining Community) and Subri (Non Mining Community)**

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### **Abstract**

*Mining has become a hot business everywhere in the world. Issues of mining are in the rouse because of the increasing demands for mineral products and shrinking nature of such minerals in the world. This seemingly opportunity for developing countries like Ghana which have mineral deposits comes with its accompanying outcomes. This paper looks at the general objective of determining how mining influences the population dynamics of the study communities (Akoti and Subiri), examine the mining operations and their effects on the health of the people living in the mining community, and determine the interventional measures of Chirano Gold mines in ensuring the safety of residents in the surrounding community. The study focused on the implications of population size and health in both Akoti and Subri communities. Special emphasis was laid on determining the implications of mining activities in terms of population size and health on the lives of the people of Akoti. Simple random sampling, systematic sampling and purposive sampling techniques were used for the study while questionnaires, observation and focused group discussion were also used as a method of data collection. The study revealed that in Akoti population increased as a result of mining and mining related diseases was also recorded while in Subri population increased steadily and non-mining related diseases were also noticed.*

**Key words:** Population, Health, Large Scale Mining

## **INTRODUCTION AND BACKGROUND TO THE STUDY**

Mining in Ghana is driven by the global paradigm which emphasis private sector led development as the engine of economic recovery in developing countries. This is indeed the thrust of the structural adjustment programme (SAP) prescription for such developing countries at the World Bank and allied institutions since the early 1980's. In these economic programs, African countries with important mining sectors were obliged to shift their policy emphasis towards the primary objectives of maximizing tax revenue from mining over the long term, rather than pursuing other economic or political objectives such as control of resources or enhancement of employment. Sixteen (16) countries were identified by the World Bank to be given

priority for explanation and private mining investment from Sub-Saharan Africa, obviously because the region is an important supplier to a variety of minerals to the world. It accounts for about 8% of world mine production. It holds more than 10% market share in six minerals—bauxite, gold, manganese, uranium, rutile, cobalt and 37% share of world diamond production.

Gold mining has played a pivotal role in the socio-economic development of Ghana for the past 200 years. According to Tenkorang (2001), the foreign exchange earnings from the export of gold rose from 107.2 million dollars to 744.2 million dollars in 1989 to 1999. From 1983 to 2002, foreign direct investment (FDI) in-flow to the

sector amounted to over 6 billion dollars. Akabzaa et al. (2004) has noted that, there is a growing dissension over the net benefit of these investments to the country as a whole and to the communities directly impacted by mining in particular. This has resulted in increasing incidence of conflict between affected communities with mining companies.

According to the annual report of Ghana Chamber of mines 2002, the government in promoting employment in the industry created appropriate environment to increase mining investment. The sector represents a substantial source of employment to the people in the mining areas of Ghana.

The activities of mining date back to the colonial era. Mining in Ghana, generally can be classified into artisanal or small scale and large scale mining. Artisanal or small-scale mining refers to mining activities that use rudimentary methods to extract and process minerals and metals on a small scale. Artisanal miners also frequently use toxic materials in their attempts to recover metals and gems. Such miners work in difficult and often very hazardous conditions and, in the absence of knowledge or any regulations or standards, toxic materials can be released into the environment, posing large health risks to the miners, their families and surrounding communities. Gold mining operations, in this context are particularly dangerous, as they often use the mercury amalgamation process to extract gold from ores.

Large scale mining, on the other hand is usually undertaken by big companies using many employees with varied skills and expertise. The companies mine at large tracts of land and continue the operations until the mineral or metal is completely excavated. One classic example of a large scale mine, that one readily remembers, is the Serra Pelada mine in Brazil which yielded 29,000 tons of gold from 1980 to 1986 and employed 50,000 workers, Goldfields Ghana Limited, AngloGold Ashanti Limited, Chirano Gold Mines, Newmount Ghana Limited. Large-scale mining in recent times has assumed alarming proportions in the mining industry. The minerals being mined in the large-scale mining sector in Ghana include gold, bauxite, diamond and manganese but the most dominant mineral commodity is gold. It contributes over 90% of the total value of minerals won in the country and has attracted the largest number of players. Currently, there are 19 operating gold mines and over 128 local foreign companies with exploration licensed to prospect for gold. The ownership structure of these mining companies is mixed, with foreign companies controlling an average of about 70% shares in these mines. The Ghana government

has 10% free share in each mine with the option to acquire additional 20% at the ruling market price (Akabzaa, 2004).

The Bibiani-Ahwiaso-Bekwai district undoubtedly has a number of mining activities going on in the district. A major characteristic of the social environment is the combination of small-scale and large-scale mining activities going on in the district accompanied by its attendant social and economic problems. This notwithstanding, the district plays a leading role in food production, forestry, oil palm and other extractive resource sectors of the economy. Giving the obvious impact of mining in three other resources, it has become imperative to study Akoti (mining community) and Subri (non-mining community) as it will provide a holistic and practical understanding of the linkages of the impacts of mining activities, to population and health related issues.

### **Problem Statement**

Ghana has a variety of mineral resources and mining dates back well into the pre-colonial times. However, since the inception of the world bank/IMF- led mineral sector reforms in Ghana in the mid-1980's, there has been a considerable increase in mining activities, particularly gold (Awudi,2002). Production of gold is dominated by homegrown Ashanti Gold Fields, which produce merely half of Ghana's total gold output (that is 37 tons) from its five mining operations in 2003 (Mbendi profiles,2004). Large-scale mines use heavy machines and chemicals underground which not only cause instability within the earth crust but also pollute underground water which serves as sources of water to various water bodies in their areas of operations. In addition, dynamite is used to blast the large rocks to aid excavation of the area where gold is extracted. The loud noise and the vibrations from the blasts affect people and animals within the surrounding communities. Cyanide, a poisonous chemical is used to recover gold from the ore, and in the process some spillages occur resulting in drainage (cyanide) into the nearby streams. This affect human health, loss of aquatic life, as these chemical are highly toxic, the chemical also seeps down into the soil causing plant roots to die.

It should also be noted that mining activities have also led to an increase in population of mining areas (communities) exerting pressure on the existing agricultural lands, increase in cost living and social amenities in the area (Ghana Chamber of Mines, 2006).The population size of mining communities is being affected by the vital role played by migrant neighbors in the communities in which the mining takes place, these

migrants are believed to play important role in HIV/AIDS transmission. In terms of how the mining industries has dealt with the problem, is yet to be recognized (Williams and Campbell, 1998, Campbell and Williams.).

Against the back drop of the population change and health implications in mining communities as discussed above, research have been done on mining, health and population dynamics, only on the communities in which the mining activities takes place. However there is a research gap to this approach. As a result, this study tries to do a comparative analysis by comparing a non-mining community to a mining community to establish whether the mining activities is solely responsible for the health and population implications on the communities in which they operate.

Against this background, a comparative research into the current population dynamics and health effects of large-scale mining (both positive and negative) in Chirano and Akoti mining area is therefore a necessity.

### **Research Questions**

1. What are the effects of mining on the population size of the communities?
2. What are the health effects of mining on the people living in the various communities?

### **Objective of the Study**

The main objective of the study is to ascertain the population size and health implications of Chirano Gold Mines on the surrounding communities.

#### ***Specific Objectives***

1. Determine how mining influences the population dynamics of the study communities (Akoti and Subiri)
2. Examine the mining operations and their effects on the health of the people living in the mining community.
3. Determine the interventional measures of Chirano Gold mines in ensuring the safety of residents in the surrounding community.

### **Significance of the Study**

Mining activities are indispensable in the economic development of any country endowed with mineral resources. This is due to the economic benefits that are made available to countries that are involved in extraction of mineral resources, both internal and external.

Internally, there is the creation of employment and revenue generation. Externally, a substantial foreign exchange is available to such countries.

Acknowledging the economic contribution of mining, however, several economies lost sight of population size and health implications associated with mining activities. Research that have been undertaken lately, to look into the population size and health implications of mining have found mining activities to be more hazardous to economic development than a blessing. Accordingly, several mining companies in the country claim to have responded to this by instituting and implementing several measures to reduce the negative population size and health implications of their activities on the people. Whether some of these measures have or are capable of reducing the negative health implications of mining on the surrounding communities is a matter of great concern.

The significance of this research lies in the fact that, it seeks to undertake a thorough and broader outlook into the population size and health implications of mining on the surrounding communities, both negative and positive, and recommend policy directives to improve the already instituted health policies by the Chirano Gold mines, as well as reducing the rate of hazardous health implications of mining activities that may be identified in Akoti and other surrounding communities. Findings and recommendations will serve as a guide to other mining companies in the country.

### **Research Methodology**

#### ***Types of Data***

The data collected included background data on respondents, perception and population size and health implications of Chirano Gold mines on the chosen communities. In addition, data on how mining influences the population dynamics of the study communities (Akoti and Subiri), the mining operations and their effects on the health of the people living in the mining community and lastly interventional measures of Chirano Gold mines in ensuring the safety of residents in the surrounding community.

#### ***Sources of data and methods of data collection***

Data for this study were from primary and secondary sources. Primary data included administering of questionnaires in the field to randomly selected residents in the chosen communities, hospital/clinic, and the mining (workers) company. This method helped the researchers to

get the relevant information from the respondents in respect to the topic. Officials and workers of health centers within both the mining community and non-mining community were also contacted for relevant information. There were formal interviews with opinion leaders in the both communities. Moreover, there were field observations to the mine and the communities especially mining community (Akoti) and other areas to determine the health and population size implications as the study sort to find out. Secondary data were picked from books, relevant articles from journals and reports of researches conducted on the impacts of mining activities on the surrounding communities especially population size and health implications. These were obtained from libraries of the University for Development Studies, the Internet and other sources. Data on mining related diseases reported at the various health centres of Akoti (mining community) and Subri (non-mining community) were key to the research.

### ***Sampling Design***

In this study, the methods of sampling were a combination of simple random, stratified and purposive sampling. The reason for this was that the data included different variables of the target population in terms of place of work, distance from the mines, perceptions on the implications on health and population size as a result of the mining activities in the community. After purposively selecting the study communities Akoti (mining community) and Subri (non-mining community), 77 respondents from Akoti (15 questionnaires were administered to the mining workers, 17 questionnaires to landlords, 15 questionnaires to health workers and 30 questionnaires to the residents). On the other hand, Subri had 79 respondents (30 questionnaires were administered to the landlords, 19 questionnaires to Health workers and 30 questionnaires to the residents. In total 156 respondents were used in the study. The justification of the sample size lies in the fact that time and resources available to the researchers were not enough to cover the entire area with a population of 1,208 people with 201 households in Akoti and Subri of estimated population of 2005 people with 404 households (Ghana Statistical Service Data, 2000). This was done to determine variations in responses regarding health and population size implications of large-scale mining in Akoti and its environs.

### ***Data Analysis***

Microsoft excels was employed to process the quantitative data and the results were presented in the form of tables

and diagrams. According to Schwandt (1997), good qualitative analysis often requires access to a range of methods. The comparative and logical qualitative analysis methods of data were adopted in the study. The comparative analysis involved taking one piece of data (questionnaires, focus group discussion and observation) in both Akoti and Subiri and compared it with each other in order to draw possible relations between various pieces of data. Data collected was summarized and stored in a statistical tables, and graphs. These included frequency distribution tables and charts. Other relevant statistical techniques were used appropriately for the analysis. Tables and diagrams as well as written descriptions were used to present data for meaningful interpretation.

### ***Scope***

The research work focused on ascertaining the population size and health implications of Chirano Gold mines on the surrounding communities. The study populations were the residents of Akoti and Subiri, mining staff and health workers from both communities.

### ***Community Profile***

Bibiani-Ahwiaso-Bekwai district is one of the administrative district of Western region of Ghana. This part seeks to present the socio-demographic features, the physical resource base, vegetation and economic activities as well as environmental situation in Bibian-Ahwiaso-Bekwai district where our communities of study is no exception.

### ***Location and Size***

The study areas are part of the Bibiani-Ahwiaso-Bekwai district in the Western region of Ghana. The district is located between latitude 6° N, 3°N and longitude 2°W, 3°W. The district has a total land area of 873km square. The district is bounded on the north by Atwima Mponua district in the Ashanti region, south by the Wassa Amenfi district, west by the Sefwi-Wiawso district (all in Western region) and east by the Denkyira north and Amansie east in the central region and Ashanti region respectively.

### ***Topography and Drainage***

The lowest and the highest point in the study area (Akoti and Subri) are 350m above sea level and 660m above sea level respectively. This highest point is also the highest in the Western region. The communities are found over a lower Birimian rocks with a gently rolling landscape and Tarkwaian rocks with topography rugged and hilly rather than smooth and flat or gently undulating. The area is characterized by magnificent drainage system with many

Table 1. Population size and growth rate in the censal periods

YEAR	MALES (Absolute)	%	FEMALE (Absolute)	%	TOTAL
1960	27,064	56.0	21,264	44	48,329
1970	27,354	50.2	27,136	49.8	54,490
1984	31,559	50.1	31,434	49.9	62,993
2000	52,867	48.7	52,867	51.2	103,256
2005	57,413	47.5	63,456	52.5	120,869

Source: National population census, 1960, 1970, 1984, 2000 and 2005.

of the rivers and streams taking their sources from the hills. The major rivers in the district include the river Ankobra and Subriso. Others forming tributaries are Awa, Krodua, Atronsu, Kroseini, Suraw, Chira and Akataso. These rivers and streams flow roughly north-south, the Ankobra into the sea and receive heavy rains; hence they have regular flow of water. It must be stressed that rivers closed to the forest and large enough can be tapped as a resources in gold mining processing, irrigation and portable water for the people in the catchment area.

### *Climate and Vegetation*

The communities (Akoti and Subri) are located in the equatorial climate with the annual rainfall average between 1200mm and 1500mm. It has a double maxima rainfall pattern, falling between March-August and September-October. The dry season is noticeable between November-January and the peak periods are June and October. The average temperature throughout the year is about 26°C. Average relative humidity ranges between 75% in the afternoon and 95% in the night and early morning. The implication here is that the climate of the area is suitable and can facilitate growth and development of gold mining activities, growing of crops both traditional and non-traditional for exports. Some of the crops include cocoa, cassava, yam, plantain, pineapple and cashew.

The whole district falls within the equatorial rain forest zone, the available tree species include odum, Mahogany and Sapele; form the basis of the flourishing Ghana timber industry. Hence, the district is a suitable location for the establishment of timber firms. There are also six (6) forest reserves in the district with the total land of about 264sq.km.

### *Mining*

The communities in the district are well endowed with the oxysols soils, which are rich in mineral deposits making mining the most important and lucrative economic activity

in the district and for the people. The most notable minerals are gold and bauxite. The companies dealing in mining in the district include; Central African Goldmines limited (CAG) at Bibiani, Chirano goldmines Limited at Akoti and Bossai Minerals limited at Awaso.

### *Geology and Soil*

The geology of the district and for that matter the communities of study is dominated by the Precambrian Metamorphic rocks of the Birrimian and Tarkwain formation. The district is endowed with rich forest Ochrosols and forest Oxysols. The soils are rich in nutrients and mineral deposits and conducive for the cultivation of food, industrial crops and mining activities respectively.

### *Environmental Situation*

#### *Erosion*

The double maxima rainfall pattern in the district has resulted in erosion in some of the communities; example includes Awaso, Asempaneye, Aboduabo and some part of Akoti. The depletion of the forest stock because of excessive lumbering, destructive agricultural practices, mining and bush burning have all led to the deforestation of the land exposing the bare land surface leading to erosion. Air pollution and environmental degradation (land) is another way mining activities affect the environment and the health of the people due to poor waste management of industrial mining waste. All this goes a long way to unfertilize the soil in the area.

### *Demographic Characteristics*

#### *Population Size and Growth*

The total population of the district keeps on increasing from time to time with special concentration in the mining communities in the district (Bibiani-Ahwiaso-Bekwai district: medium term development plan, 2010). (Table 1)

Table 2.A comparison between district and national population growth rate

YEAR	DISTRICT(BIBIANI-AHWIASO-BEKWAI)	NATIONAL(GHANA)
1960-1970	1.2%	2.4%
1970-1984	1.7%	2.5%
1984-2000	3.2%	2.6%
2000-2005(projected)	3.2%	2.6%

Source: Ghana Statistical Service, 2010.

The increase in the population in the district over the years could be attributed to the presence of mining activities according to the survey conducted by the Bibiani-Ahwiaso-Bekwai district in 2010. The natural increase figure for the district is 15 as against the national figure of 15 in figure being positive has the tendency to cause a steady rise in population of the district with time. (Source: Population Reference Bureau/ Data Finder- Ghana, 2004). (Table 2), shows inter-censal growth rates of the district over the past years.

### *Age, Sex Structure and Migration*

Children between the ages of 0-14 years constitute 38.5% of the population. Old people 65+ years and above constitute 3.0% of the population while the remaining group 15-64 years accounts for 58.5% of the population (Medium Term Development Plan 2010: Bibiani-Ahwiaso- Bekwai district). In terms of sex distribution, female constitute 52.5% of the total population while males accounts for 47.5% of the population. This unusual population structure is due to the high migration rate of people to the area in search of jobs in the district and for that matter, the communities (Akoti and Subri). The medium term development plan 2010, of the district attributed the high in-migration into the district to the following reasons:

That the district is one of the dominant areas in the country noted for cocoa cultivation and as such people locate themselves there to engage in the farming activity. Again the area is much endowed with mineral resources and these also attract people to the district. They indicated that; if the situation is not controlled can adversely affect the existing social amenities in the district.

### *Economic Activities, Health and Mining*

The mining and the farming industry is considered the most important economic activity in Akoti and Subri.

There is increasing concentration of mining activities and mineral prospecting going on the district. In addition, the only bauxite mine is located in the district. Other economic activities include small scale mining industries, wood and timber companies, carving, craft, carpentry, tailoring, blacksmithing and others.

The process of mining and processing of minerals involves various activities, which give rise to various related diseases. During processing, toxic chemicals such as cyanide, arsenic, sulphur dioxide and other gases are used with very serious health consequences. According to Akabzaa (2000), in his book, Environmental and Social Impact of Mining in the Wassa West District of Ghana Page 39, the District medical officer of health Dr. Avotri said the common mining related diseases observed over the years include; malaria, diarrhea, upper respiratory diseases, skin diseases, acute conjunctivitis and accidents constitute the ten top diseases in the district. This indicates that, mining in Akoti (mining community of the study) may also have one or two consequences on the lives of the people.

### *Ethnicity and Religion*

The communities (Akoti and Subri) are dominated homogeneously by Akan with a percentage of 79.4% and the remaining percentage is shared among Ewes (12.7%), and Northerners (7.9%). The major religion in the communities is Christianity which takes 88.7% of the population. The others are; Muslims (7.5%) and traditional religion (3.8%). The large number of Christian in the communities can enhance the mobilization of funds among the Christians and other religions fraternity to support development projects.

## **LITERATURE REVIEW**

This part aims at reviewing literature on what has been done (researched) Mining and how it contributes to the socio-economic development of countries endowed with

mineral resources. Mineral resources and mining effects can be seen in two ways; good and bad implications. Whereas some researchers highlight the benefits of mining to socio-economic development, others focus on the negative impacts of mining on the overall development of such economies. Here focus was specifically on reviewing what has been documented regarding mining as a concept, processes involved in mining and the methods employed in ore extraction. It further looked at the relationship between mining and health implications as well as mining and population size impacts in the selected communities.

### **Definitions, Processes and Methods of Mining**

Mining is the removal of minerals from the earth's crust in the services of man (Down and Stock, 1977). Ghana's minerals and mining law PNDC Law 153 defined mining as 'the activities relating to the extraction of any substance in solid or liquid form occurring naturally in or on the earth or under the seabed formed by or subjected to geological process including building and industrial minerals'. The Encarta Encyclopedia also defines mining as the process of obtaining useful minerals from the earth's crust. The process include excavations in underground mines and surface excavation in open pit, open cut (strip) mines. It also defines minerals as any naturally occurring substances of definite chemical compositions and consistent physical properties. Mining is the extraction of valuable minerals or other geological materials from the earth, usually from an ore body, vein or (coal) seam. Materials recovered by mining include base metals, precious metals, iron, uranium, coal, diamonds, limestone, oil shale, rock salt and potash. Any material that cannot be grown through agricultural processes, or created artificially in a laboratory or factory, is usually mined.

Mining in a wider sense comprises extraction of any non-renewable resource (e.g., petroleum, natural gas, or even water, Antwi (2010). From archaeological evidence, it is on record that the oldest mine known is 'Lion Cave' in Swaziland. Basically, there are eight steps to mining process: Prospecting to locate ore, exploration to defining the extent and value of ore where it was located, conduct resource estimate to mathematically estimate the extent and grade of the deposit, conduct mine planning to evaluate the economically recoverable portion of the deposit, conduct a feasibility study to evaluate the total project and make a decision as whether to develop or walk away from a proposed mine project. This includes a cradle to grave.

Analysis of the possible mine, from the initial excavation all the way through to reclamation, development to create access to an ore body, exploitation to extract ore on a large scale, reclamation to make land where a mine had been suitable for future use.

There are four basic types of mining methods. Firstly, materials may be mined from surface mines, open pits, quarries, or other diggings open to the atmosphere. This group constitutes by far the greatest number of mines in the world. Secondly, there are underground mines, entered through shafts or tunnels. Thirdly, there is the recovery of minerals and fuels through boreholes. Finally, there is underwater mining or dredging, which is now extending to the potential mining of the deep oceans (Encarta, 2007).

### **Mining Operations and Population Dynamics**

The Macmillan English dictionary for advanced learners defines population as all who live in a particular area (2005). Acquah, (2000) also indicate that population is the total number of people residing or living in a given geographical area or country within a given period of time. Population as a concept is therefore dynamic in terms of size, structure and distribution and growth rate. The twentieth century has been a century of unprecedented population growth, an economic development and environmental change. From 1900 to 2000, world population grew from 1.6 billion to 6.1 billion persons (United Nations, 2001a). However, while world population increased close to 4 times, world real gross domestic product(GDP) increased from 20 to 40 times (DeLong, 1998), allowing the world not only to sustain a fourfold population increase, but also to do so at vastly higher standards of living. Nevertheless, this rapid population growth and economic growth occurred unevenly throughout the world and not all regions have benefited equally from economic growth. Moreover, population growth and economic development occurred simultaneously with increasingly unsustainable utilization of the earth physical environment.

Decision of the interrelationship among population, environments and economic development long precedes the writings of Thomas Malthus in the late eighteenth century. Since ancient times statesmen and philosophers have expressed opinions about such issues as the optimum number of people and the disadvantages of excessive population growth (United Nations, 1973a). The recurrent term was the balance between population and natural resources conceptualized as means of substance or more concretely, food and water. Not all theories saw population

Table 3. World historical and predicted crude birth rate (1950-2050)

YEARS	CBR	YEARS	CBR
1950-1955	37.2	2000-2005	21.2
1955-1960	35.3	2005-2010	20.3
1960-1965	34.9	2010-2015	19.4
1965-1970	33.4	2015-2020	18.2
1970-1975	30.8	2020-2025	16.9
1975-1980	28.4	2025-2030	15.8
1980-1985	27.9	2030-2035	15.0
1985-1990	27.3	2035-2040	14.5
1990-1995	24.7	2040-2045	14.0
1995-2000	22.5	2045-2050	13.4

growth in a negative light. In particular, mercantilist ideas in Europe during the seventeenth and eighteenth centuries saw the positive aspects of large and growing populations and favored policies to encourage marriage and large families. Members of the Julian Simon School emphasize the positive aspect of large and growing populations (Simon, 1981, 1990, 1996).

In the early years of the United Nations, when world population was slightly more than a third of its present size, environmental issues in relation to population and development tended to be framed in terms of the natural resources needed to sustain population growth and economic development. From the above it is clear that, global population has been increasing due to high prospecting of natural resources for economic development.

#### ***Population size and growth rate***

Population size is the number of individual organisms in a population. It is expressed as the population present at particular instance (Wikipedia, 2008). Ghana's population has been increasing steadily over the years. High population growth rate has therefore been identified as a major demographic issue in many countries. The population of Ghana grew from 6.7 million in 1960 to 8.5 million in 1970. This gave an intercensal growth rate of 2.4% per annum. Between 1970 and 1984, the population increased by over 40% to 12.2 million, giving a growth rate of 2.6% between the two periods. In 2000, Ghana total population was 18.9million with annual growth rate 2.4% between 1984 and 2000. Thus between 1984 and 2000, the percentage growth was 53.3%. In effect the population

increased by 6.5 million between the same period. The annual growth of Ghana's population has been ranging between 2.0% to 4.0% since the 1960's. The growth rate however varies from region to region and from one locality to another. (Population-1995 National population and housing census Report, 2000).

Birth rate along with death rate and migration rate are commonly used to calculate population growth or size. Birth is typically the rate of births in a population over time. Generally, the rate of birth in one population is calculated using live birth counts from a universal system of registration of birth, death and marriage, and population count from a census or using estimation through specialized demographic techniques. The crude birth rate is the number of childbirth per 1000 people per year. It is important to distinguish between a total or crude birth rate which uses all birth, typically indicated birth per 1000 versus an age-specific rate which is typically indicated as the number of birth per 1000 persons in a population. The first known use of the term 'Birth rate' in the English language was in 1859. Table 3

As of 2009, the average birth for the whole world is 19.95 per year per 1000 of total population, a 0.48% decline from 2003 World birth rate of 20.43 per 1000 of total population (UN, medium variant, 2008). Birth rate is an issue of concern and policy for a number of national government and district assemblies in Ghana.

Death rate represents the average annual number of death during a year per 1000 population at a mid-year; also known as crude death rate. The death rate while only a rough indicator of mortality situation in a country, accurately indicate the current mortality impact on

population growth (CIA, World Factbook, 2012). The death rate is often expressed as the number of death per 1000 of the population per year and also called fatality rate. The death rate; crude (per 1000 people) in Ghana was 8.00 in 2009 and 8.20 in 2008 according the World bank report published in 2010.

Migration is the permanent or semi-permanent movement of people that leads to a change of residences from one area to another (Amankwaa, 2003). This may cover short distances (less than 10km) or long distance (over 1000kms). Thus, migration is the movement of people from one area to the other at a giving time. Migration can increase population size by spreading the people over a wider area where there may be more resources. Migration into a single habitable area will increase the population density, but could cause either a numerical increase or decrease in a population. As a result of the presence of mining activities in most part of the world especially Ghana, people living near mining areas or mining villages are very much disturbed and affected by the impact of mining. Theft, drugs/alcohol, prostitution, rape, cultural degradation and sexual abuse are unfortunately some of the worst problems of people living in mining areas as a result of migration (Mining and the environment particulars, 2008).

The mining sector has been affected by world-wide epidemic of HIV/AIDS, and this is apparent in the studies of South Africans Mines. The population size of mining communities is being affected by the vital role played by migrants neighbors in South African mining sector, these migrants are believed to play important role in HIV/AIDS transmission. In terms of how the mining industry has dealt with the problem, it is yet to be recognized (Williams and Campbell, 1998, Campbell and Williams, 1999). It also came to light through the literature review that Sexually Transmitted Diseases (STD) are on the increase. There are increased cases of syphilis and HIV in the area. The main cause of the increasing incidence of STD is also attributed to the large expatriate employees who patronize the prostitutes in the area. Another group blamed for the spread of STD is the galamsey community. The galamsey operators have been described as having a high propensity to spread and therefore attract a lot of prostitutes to their work sites (Akabzaa, 2000). According to Akabzaa, 2000, mining impact related diseases such as malaria, diarrhoea, upper respiratory diseases, skin diseases, acute conjunctivitis and accident are the top ten diseases in most mining communities. Apart from the above diseases, a number of mining related diseases are said to be on the increase. Reported cases of mental disorders are on the

increase. Again, mental cases related to arsenic dermatitis have been observed 27 in the Bogoso area where Bogoso Gold Mines operates an open pit gold mine (Akabzaa, 2000). The process of gold mining and processing involve various activities which give rise to various environmental related diseases. During the process of mining, blasting excavates rock. The blasting is accompanied by thundering noise and vibration of the ground. It produces a lot of dust, thus, increasing the particulate matter in both air and water (Antwi, 2010).

### Health and Mining

Health is the level of functional or metabolic efficiency of a living being. (Wikipedia free encyclopedia 2011). The Merriam-Webster dictionary, defines health as ‘the general condition of person’s mind, body and spirit, usually meaning to be free from illness, injury or pain’. The world health organization (WHO) in 2006, defines health as ‘a state of complete physical, mental and social wellbeing of an individual, not merely the absence of disease and infirmity’. The ‘Ottawa charter for health promotion’ furthered that health is not just a state, but also ‘a resource for everyday life, not the objective of a living’. The term health is also widely used in the context of many types of non- living organization and their impacts for the benefits of humans, such as in the sense of healthy communities, healthy cities or healthy environments. Health related problems come from different activities of man on the earth surface such as mining, farming, migration, industrializations and others.

The connection between a healthy environment and health, productive communities are significant. There is a combination of physical, chemical, biological, political, social, economic and cultural factors that relate to how people experience the environment around them (Corvolan et al.1999). From environmental health perspective, this complex interrelation mandate that these issues are not addressed in the health centre, but also as broader issues of every segment of society. Moreover, the connections between economic development and health are also relevant. A Cornerstone policy document addressing health and development in 1990’s was the World Bank 1993 World Development Report entitled Investing In Health (WB, 1993). In recognition of this major topic in the health centre, former WHO Director-General established the commission on macroeconomics and health (CMH) in January of 2000 to access the interrelationship between health and global economic development. Attention has been to the occupational and environmental health impacts

of mining practices for artisanal and Large-Scale miners and communities within close proximate of such activities. Health and safety risks associated with large-scale mining are complex and dependent on the mineral mined, depth of mining and its scale (Aherns and Stephens, 2001). Migratory labour at mines in African countries such as South Africa has been identified as a major factor in the spread of HIV/AIDS (Campbell, 2000; Campbell and Williams, 1999; Jochelson and Mothbeli, 1991).

Available document examines the implications of mining on the health of workers and the people within the surrounding communities of the mines. Studies of mining and health by types and the process of mining are divided into deep and open cast mines. Deep mines produce severe harms for employees in terms of their risk of high blood pressure, heat exhaustion; myocardial infection and nervous system disorders. Studies on surface mining focuses on coal, granite and rock mining and health risks are related to dust breathing. In all levels of mining health risks occur with dust exposure (Stephens and Ahern, 2001).

Mining affects our health through the heavy use of water in processing ore and through water pollution from discharged mine effluent and seepage from tailings and waste rocks impoundments. Increasingly, human activities such as mining threaten the water sources on which we all depend for our survival. Water has been called “mining’s most casualties” (James Lyon, interview, Mineral Policy Centre, Washington D.C). There is growing awareness of the environmental legacy of mining activities that have been undertaken with little concern for the health of the people and the environment.

Another way in which mining operations affect the health quality of the workers, community members is through water course destruction. Gold mining can deplete surface and ground water suppliers. Ground water withdrawals may damage or destroy stream habitat many miles from the actual mine site. For example, in Nevada, the driest in the United States of America, the Humboldt River is being drained to benefit gold mining operations along the carline Trend. Mines in the North Eastern Nevada desert pumped out more than 580 billion gallons of water between 1986 and 2001-enough to feed New York City’s taps for more than a year. Groundwater withdrawn from the Santa Cruz River Basin in Southern Arizona for use at nearby copper mine is lowering the water table and drying up the river (Environmental Mining Council of British Columbia,2000)

The Ghanaian Chronicle issue of 25<sup>th</sup> July, 2003 carried the story attributed to the Regional Programmed Officers of Environmental Protection Agency (EPA), that Ghana is listed among countries in Africa that would experience

water stress of 1700, cubic meters or less per person annually by 2025. This is due to the pollution of water bodies by most operating mining companies in Ghana, which will consequently affect the health of the people in the nearest future.

Mining is an activity classified as the most polluting as well as drawing the dwindling water resource in the world. A study conducted by Economic Commission for African (ECA) in 1999 on the water situation in African countries, specifically, cited Ghana as being one of the most water stressed countries.

In Ghana, the effects of the activities of mining companies on our water bodies through dewatering, groundwater pollution, the virtually free use of water for mining operation, pollution of streams through cyanide and other waste spillages, are affecting the health of residents of mining communities. According to Duker et al. (2005), a positive relationship between exposure to arsenic in contaminated water bodies, soil and food crops to the occurrence of Buruli Ulcer disease by residents of Amansie East District of Ashanti region in Ghana, emphasizing health problems as a result of mining activities in the area.

A study of this nature as health is concern need to establish scientifically the levels of lead arsenic, mercury, copper, manganese, cadmium, zinc and iron that mining activities will release into water bodies of their catchment area. A report issued by Commission on Human Rights and Administrative Justice (CHRAJ, 2008), reveals that most water bodies in Obuasi mining area has been polluted with toxic chemicals such as lead, mercury, cadmium, zinc, arsenic, iron and that these chemicals have bio-accumulated in the water bodies as a result of the fact that, they are being continually released into the environment. The report further revealed that, residents of communities within the Obuasi mining areas have suffered certain diseases because of their continual use of water bodies loaded with heavy metals.

In Ghana, available document on the effects of mining on health of the people (community’s members) and workers are indicated as follows. In Tarkwa area, with the initiation of mining investment, mining impact related diseases such as malaria, diarrhea, upper respiratory tract infections, skin disease, acute conjunctivitis and accidents constitute the top ten diseases in the area according to biostatics, obtained by friends of the earth- Ghana in a survey 2001.

According to Darimani, (2001), the area has the highest incidence of malaria in the western region and the country as a whole. Skin rashes are widespread particularly among communities living along rivers and streams which

regularly receive leaked cyanide waste waters and other mining waste within concessions (Akabzaa, et al. 2001).

In Ghana, health related environmental monitoring mandated in mining areas by Ghana's national environmental policy include monitoring air, water, noise, emissions and food contamination (minerals commission and environmental protection council, 1994). There is current evidence of long- term impact of mining on health of workers and communities. This implies that the sector's activities currently undermine the human objectives of sustainable development, which are to protect the health of current and future generations. There is still a long way to go, before mining becomes a healthy work or healthy development activity to take place in a community (Stephens and Ahern, 2001).

### Implications of Mining Operations

Practically all the large scale mining companies in the country employ the open-pit method of mining in addition to cyanide heap leach operations. These methods have far-reaching consequences for human health and environmental safety (Akabzaa, 2000). The use of heavy machinery in exploiting the minerals also has a destructive effect on the vegetation as it generates more dust (ILO, 2005) and noise pollutants. Though mining projects may generally have weak links with the rest of a host national economy, they can have a decisive impact on the communities in which or near which they are located (Anyemedu, 1992). Reforms in the Ghanaian mining industry have not received corresponding reforms in the other sectors (e.g., the environment and health sectors) to accommodate the potential impacts arising from an accelerated growth in the mining industry. This situation has led to adverse effects not only on mining communities but the economy at large. An attempt to quantify annual losses to the economy through environmental degradation by the Environmental Protection Council in 1988 put conservative estimates at 41.7 billion cedis (old Ghana cedis), the equivalent of 4% of total GDP. Just as the benefits accrued from the industry appear huge so are the problems that emanate from mining operations. The implications of mining operations in Ghana both from the large and small scale miners are diverse and quite devastating for it touches on the livelihood and the very existence of people. The principal elements of the environment (i.e., land, water and air) have been severely affected by mining activities in Ghana. Large tracts of land for farming activities have been acquired by mining

companies for large scale surface mining operations depriving mining communities of their source of livelihood (Akabzaa and Darimani, 2001). Sporadic cyanide contamination of water bodies by large scale surface mining operations and mercury contaminations from small-scale and illegal mining activities are common features of mining communities. Statistics from the Inspectorate Division of the Minerals Commission on occupational health problems caused by mining activities from 2000-2004 includes malaria and upper respiratory tract infection, the two topmost causes of outpatient morbidity between 2000-2006 (Ghana Health Service, 2007). Quite informative on the statistics of diseases is the inclusion of sexually transmitted diseases. Most mining towns in Ghana hide a number of commercial sex workers some of whom migrate to these towns in search of jobs or with the intention of trading, the failure of which compels them to turn to prostitution as the last resort. The trend for reported cases of HIV in the Wassa West district of the Western region has been on the increase since 1992. Recording 6 cases in 1992, 25 in 1993, 37 in 1994, 68 in 1995 and as large as 100 cases in 1996. It is believed that the growing incidence of HIV cases in the Wassa West District, the highest in the Western Region, is due to the increased incidence of sex trade in the area. But what might be cause of this awful incidence? Perhaps, the concentration of mining companies in the area. The use of illicit drugs (e.g., marijuana and cocaine) as stimulants to work harder is also taking root particularly amongst illegal and small scale miners in Ghana.

Other health and social impacts created by mining activities includes hearing losses and silicosis, conditions created by the blasting and drilling activities with their resultant noise and dust, which have become nuisance in the mining regions. Large scale surface mining unlike the underground mining of the past has taken up large tracts of farmlands from mining communities. Meanwhile, an operation in this area is more capital intensive than it being labour intensive. Thus it requires less and very skilled labour to operate the very multifaceted equipment used in the exploitation and processing of minerals. This situation coupled with the increased migration to mining communities in search of jobs has worsened the unemployment situation in these areas. It has also created other social problems as overpopulation, congestion, and pressure on social amenities among others. Thus the "gains" from the sector in the form of increased investment and foreign exchange earnings are being achieved at some significant environmental, health and social costs to the

people living in mining communities and the nation as a whole.

### **Challenges Posed By the Mining Industry**

In spite of the positive economic implications of mining in the development of an economy, some researchers and other Non-Governmental Organisations (NGOs) continue to be on the heels of mining companies trying to discourage their operations in developing countries. Sachs and Warner (1999) indicate that natural-resource intensity is negatively associated with both the quality of legal and government institutions in a country and the degree to which an economy is open to international trade. According to them the more dependent a country is on natural-resource exports, the poorer the quality of institutions and the more closed an economy tend to be to in international trade (Sachs and Warner, 1999).

According to the most literatures reviewed, the compounding population and health cost and damages of mining activities far outweigh their economic and social benefit, the magnitude of which cannot be quantified. There is therefore high health and population pressure incurred as a result of mining activities in most communities around the world. Ross (2001) in his review of the oil, gas, and mining sectors in developing countries concludes that; “the best course of action for poor states would be to avoid, export-oriented extractive industries all together, and instead work to sustainably develop their agricultural and manufacturing sectors that tend to provide direct benefits for the poor, and more balanced form of growth” (Ross, 2001). This comment is however at variance with that of Richards, (2002) who asserts that: “farming and forestry have a far larger footprint than mining, and probably a far greater negative environmental impact if the effects of fertilizers and pesticides are considered” (Richards, 2002). Friends of the Earth, an International NGO, in a position paper released in 2000 calling for the phasing out of public financing for mining and fossil fuel projects argued that “extractive industries do not foster sustainable development or alleviate poverty” (Friends of the Earth, 2000). The industry by its very nature is a “foot print industry” thus it leaves an environmental, social and economic impact wherever it finds itself (World Bank, 2002). Poorly managed impacts on the environment and social fabric of society can reflect negatively on the economic parameters. It is therefore important to conduct a cost benefit analysis of the industry’s operations and to mitigate any negative implications in order to gain the desired profits of the

industry. Mining exploration and production activities inevitably cause physical and material damage not only to the environment but also to the inhabitants therein (Veiga, and Beinhoff, 1997; Warhurst, 1994; 1999).

The creation of large scale surface disturbances, the generation of volumes of waste materials and the exposure of formerly buried geological materials to the forces of oxidation and precipitation are basic to the mining industry and may continue to present complex environmental and health problems even when the best available practices are carefully followed (Chiaro and Joklik, 1998). The use of chemicals and explosives in many areas of mining also create health and safety hazards by exposing the environment to pollutants like chemicals, dust, and fumes. In the past two decades, environmental issues have received an impetus in mining operations; taking a centre stage in mining related issues (Omalu and Zamora, 1999). The environmental costs of mining are now being viewed as an additional tax. It has therefore become a standard practice to see Environmental Impact Assessments (EIAs) and Environmental Action Plans either in mining agreements or in general mining legislation. The Philippines was among the very first of the developing countries to adopt environmental impact assessment through legislation. This was done by a presidential decree (Presidential Decree No. 1121) which created the National Environmental Protection Council (now the Environmental Management Bureau) to formulate policies and issue guidelines for the establishment of environmental impact assessments. In Ghana, the national environmental policy requires mining companies to undertake an environmental impact assessment before they can be granted approval for a project. Another important issue is that of the reclamation of shattered mine site. In Ghana, mining investors in addition to Environmental Impact Systems (EIS) are required to prepare an initial reclamation plan to achieve specified minimum standards before being granted the permit to operate. Mining companies are sometimes required to provide some funds to be placed into escrow accounts, which are made available to fund restoration/reclamation expenses, when the operator closes down. The escrow account thus acts as both a security and a tax-efficient funding device for the required reclamation work. Modern agreements in the developing world tend to devote more attention to environmental issues than issues of employee safety and quality of life. This is so because while most developed countries have well developed systems of environmental mining regulation, most of these systems are not appropriate for developing countries, neither are they practical nor desirable for implementation

in developing countries (Otto and Barberis, 1994). However, most large scale mining operations in the developing world are being carried out by companies with backgrounds from the developed world, which makes the transfer of environmental systems difficult. While in recent years mining companies have become more aware of the need to address environmental issues and to incorporate environmental management systems into their overall policy, there are still issues to be addressed in terms of the social and health impact a mine may have on its employees and the local community at large.

Indeed, issues of quality of life and health and safety of employees who work under difficult and dangerous conditions cannot be said to be adequately addressed in today's mining industry, especially, in the developing world. Employment levels have fallen in many mining companies as a result of decreased productivity, radical restructuring and privatization of the mining sector by the government of Ghana. This change has not only affected mine workers who have to look for alternative employment, but also those remaining in the industry and have to work in very different ways, requiring more skills and more flexibility. Finding the balance between the desire of mining companies to cut costs and the determination of workers to safeguard their jobs compounds the already existing issue of health and safety in the mines. This is because as masters of mines seek sudden huge profits, the miners' life value is more likely to be trampled upon at the expense of expensive safety equipment. Desperate employees who are also very determined to safeguard their jobs will go every length to do so forgetting about energy sapping protective equipment which would not allow them achieve their production targets. Against the back drop of the population change and health implications in mining communities as discussed above, research have been done on mining, health and population dynamics, only on the communities in which the mining activities takes place to ascertain really that the presence of the mining activities is much solely to be blame for the sufferings associated with it. However there is a research gap to this approach. As a result, this study tries to do a comparative analysis by comparing a non-mining community to a mining community to establish whether the mining activities is solely responsible for the health and population implications on the communities in which they operate.

## DATA ANALYSIS AND PRESENTATION

This part focuses on the analysis and presentation of data gathered through the use of research instruments: questionnaires, observation and focus group discussions with the residents of both the Akoti and Subiri. A questionnaire based on the aims and objectives of the study was designed and administered to both male and female respondents. In all, one hundred and fifty-six (156) questionnaires were administered to seventy-seven inhabitants in Akoti and seventy-nine inhabitants in Subiri. Finally, a focused group discussion was organized in Akoti and Subiri to ascertain whether the mining operations have either health or population size implications in their communities.

### Socio-Demographic Background of Respondents

This section discusses the socio-demographic background of respondents interviewed. The need to describe the socio-demographic background of respondents stems from the fact that, the social and economic conditions of people invariably influences their responses to situations and problems. The research involves a comparative study of both mining community and non-mining community in relation to health and population size implications.

#### *Gender Distribution of Respondents*

The pie chart (Figure 1) represents the gender distribution of the respondents. Sex is one of the important demographic variables because many demographic events are determined by sex. Out of the total number of one hundred and fifty-six (156) questionnaires administered; 57% were males while 43% were females in the communities. The over representation of males is as a result of many young men migrating from other part of the country to seek for jobs in the district, especially in the mining communities.

#### *Occupational Distribution of Respondents*

The pie chart (Figure 2) represents the occupational distribution of respondents. Job opportunities present in an area invariably determine the standard of living of the people in the area. From the figure, 46.15% of the respondents are engaged in farming activities, 16.02% are engaged in mining activities, 21.15% are engaged in health service, 8.33% are engaged in petty trading, 2.56% are also students, 4.48% engaged in the teaching profession and pastor represents 1.28%. From (Figure 2), it could be

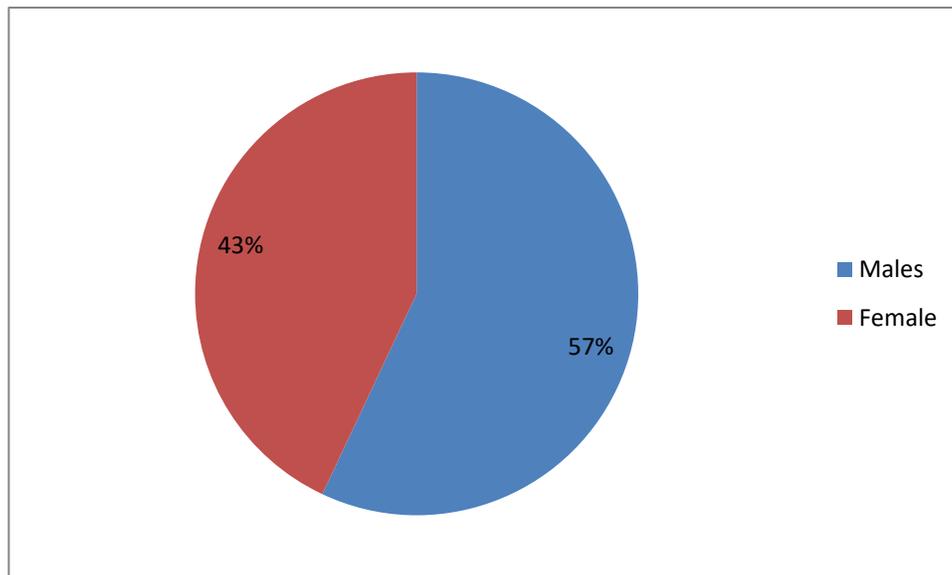


Figure 1. A Pie Chart Representing Gender Distribution of Respondents  
Source: ERS Researcher Field Survey, 2012.

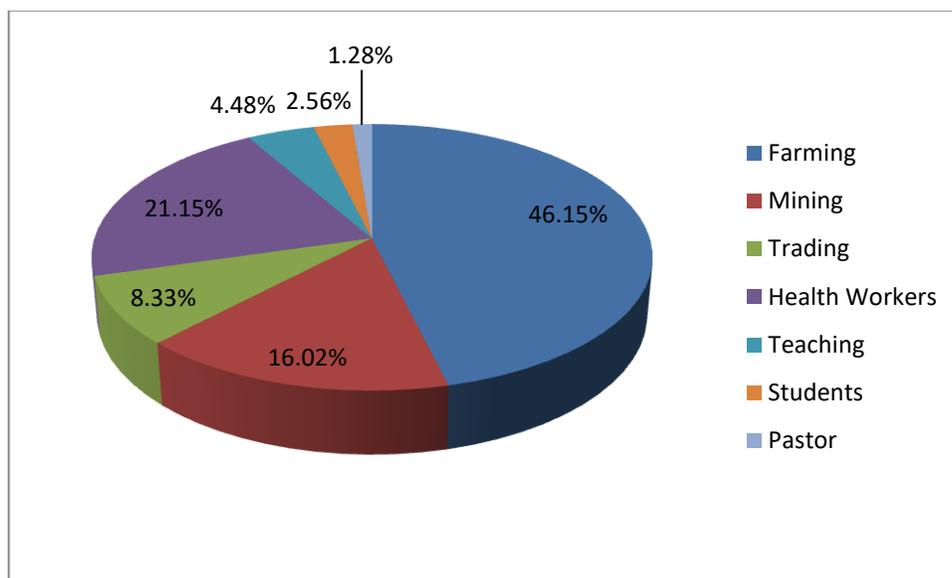


Figure 2. A pie chart representing the occupational distribution of respondents  
Source: ERS Researcher 48 Field Survey, 2012.

observed that farming activities is the major occupation of the respondents and represents 46.15% of the occupational distribution of the respondents. Health workers represent the second largest occupation of the respondents in the area, which represent 21.15% of the total respondents while mining is the third largest occupation of respondents representing 16.02%. Considering these three major occupations, (Farming, Health workers and Mining) to be

going on side and side competing for space, it could be a recipe for land use conflicts in the area.

### **Mining Activities and Population Dynamics**

The study seeks to use the various economic activities, tenants and the cost of renting to ascertain how mining influences population dynamics in both communities. Table 4 displays the various economic activities in both

Table 4. Comparison between the various economic activities in both Akoti and Subiri

AKOTI	SUBIRI
Farming	Farming
Trading	Trading
Teaching	Teaching
Lumbering	Lumbering
Artisan workers	Artisan workers
Mining	N/A

Table 5. Showing the total number of people in 17 and 30 houses in Akoti and Subiri

COMMUNITY	YEAR					
	2005	2012	Total	% of 2005	% of 2012	% Increase or Decrease
AKOTI	100	130	230	43.5	56.6	13.1
SUBIRI	288	307	595	48.4	51.6	3.2

Source: ERS Researcher Field Survey, 2012

Table 6. Determining increase or decrease in population using tenants as a determinant

TENANTS	AKOTI				SUBIRI			
	2005	%	2012	%	2005	%	2012	%
Farmers	8	29.6	5	9.6	6	24	9	23.1
Traders	5	18.5	8	15.4	5	20	6	15.4
Miners	4	14.8	31	59.6	1	4	3	7.7
Teachers	4	14.8	6	11.5	7	28	9	23.1
Health workers	6	22.2	2	3.8	6	24	11	28.2
Pastors	-	-	-	-	-	-	1	2.6
Total	27	100	52	100	25	100	39	100

Source: ERS Researcher Field Survey, 2012

Akoti and Subiri. It is clear that Akoti has a comparative advantage in terms of economic activities as Akoti recorded mining over Subiri. According to most respondents especially in Akoti, mining serves as a pull factor of people into the community.

The Benefits of Mining to Akoti Community

1. Employment, Revenue to the people, Market, Tourism, Infrastructural development Education/scholarship

The above benefits of mining to the community (Akoti) were recorded from respondents in the mining community. This serves as incentives to a lot of people who migrate into the community.

In line with the objectives of the research, 17 landlords and 30 landlords were sampled among the targeted population

in Akoti and Subiri respectively. Respondents were sampled for the purpose of determining how mining influence population growth of the communities.

(Table 5) indicates how the population of the communities has increased or decreased using 17 landlords in Akoti and 30 landlords in Subiri in 2005 and 2012. From (Table 5) comparing the pace of increase in population in both Akoti and Subiri, it was realized that the difference in percentage of 2005 and 2012 in Akoti was 13.1% while that of Subiri was 3.2%. This implies that Akoti's population has increased faster than Subiri as a result of the mining activities in the community

(Table 6) indicates how the population of both Akoti and Subiri has increased using tenants as the case study. In

Table 7. Respondents views on cost of renting as a result of mining

Category	Akoti	Subri
Cost of renting in 2005	GH¢ 30.00 to GH¢85.00	GH¢ 10.00 to GH¢60.00
Cost of renting in 2012	GH¢ 90.00 to GH¢ 160.00	GH¢ 25.00 to GH¢100.00

Source: ERS Researcher Field Survey, 2012.

Table 8. The Various Mining Related Environmental Factors and Its Associated Diseases in Akoti

MINING RELATED ENVIRONMENTAL FACTORS	DISEASES
Polluting of water bodies using chemicals such as mercury, cyanide, zinc etc.	Diarrhoea, intestine worm, malaria, bilharzia, skin diseases.
Tailing dams	Malaria, fever, skin disease, diarrhoea
Dynamite (blasting of rocks)	Skin disease, respiratory diseases, cold and catarrh and injuries.
Stagnant waters	Malaria, fever, diarrhoea.

Source: ERS Researcher Field Survey, 2012.

Akoti the mining operation started in 2005 and recorded 27 tenants with farmers being 29.6%, health workers 3.8%, traders 18.5%, teachers 14.8% and miners 14.8% respectively. In 2012, when the study was conducted mining tenants in the community were recorded to be 31 representing 59.6%, traders 15.4%, teachers 11.5%, farmers 9.6% and health workers 3.8%. The increase from 14.8% mining tenants in 2005 to 59.6% mining tenants in 2012 shows the tendency of the mining activities to increase the population in the community (Akoti) while in 2005 Subiri recorded only 4% tenant to 7.7% tenants increase in population in terms of mining workers but recorded a significant increase in other occupation such as farming, health workers, teaching, trading etc. Though the population of the non-mining community increased; but most respondents in Subiri attributed it to other economic/social workers rather than mining. To confirm the increase in population of both Akoti and Subiri, the Bibiani-Ahwiaso-Bekwai district in their medium term development plan (2010) indicated a high in-migration into the district especially mining communities such as Akoti, Awaso, Bibiani, etc. to the following reasons:

1. That the district is much endowed with mineral resources and these also attract people to the district especially mining communities.
2. That the district is one of the dominant areas in the country noted for cocoa cultivation and as such, people locate themselves there to engage in this farming activity.

To conclude, it is worth to note that mining activities in Akoti has caused an increase in population and concrete measures needs to be adopted to reverse the future impacts on the existing social amenities in the community (Akoti). Respondents views on the cost of renting in the communities as a result of mining activities was also gathered to augment how the mining activity has impacted on the people in the communities.

The (Table 7) shows how the mining activities have impacted on the cost of renting in the communities. Using 2012 as a reference year, in Akoti the cost of renting increased from GH¢ 90.00 to GH¢ 160.00 as a result of mining and the rate at which more people are coming into the community (Akoti). According to the respondents, in the non-mining community in 2012, the cost of renting increased from GH¢ 25.00 to GH¢100.00 and respondents attributed it to the presence of health workers, teachers, traders and others but not mining activities.

### **The Mining Operations and Their Effects on the Health of the People of Akoti and Subiri**

Associated with the numerous benefits resulting from mining activities, there is also some health implications connected with the mining activities. By comparing the health implications of mining activities in both Akoti (mining community) and Subiri (non-mining community), (Table 8 and Table 9) respondents were quick to note that in Akoti, diseases endemic in the community is directly

Table 9. The Various Environmental Factors and Its Related Diseases In Subiri

ENVIRONMENTAL FACTORS	DISEASES
Chock and stagnant waters	Malaria, diarrhoea, fever, bilharzias.
Poor disposal of waste	Malaria, diarrhoea.
Animal droppings	Malaria, diarrhoea, fever
Changes in the weather	Fever, skin disease, malaria

Source: ERS Researcher, Field Survey, 2012.

Table 10. Comparing Common Diseases in Akoti and Subiri

DISEASES	COMMUNITY			
	AKOTI		SUBRI	
	FREQUENCY	%	FREQUENCY	%
Malaria	38	49.35	41	51.89
Cold and Catarrh	23	29.87	3	3.79
Skin disease	4	5.19	5	6.32
Fever	5	6.49	22	27.84
Diarrhoea	1	1.29	7	8.86
Eye and heart	2	2.59	-	-
Chest pain	4	5.19	-	-
Injuries	-	-	1	1.29
Total	77	100	79	100

Source: ERS Researcher, Field Survey, 2012.

and indirectly associated with the mining activities and other social/economic activities such as farming and others while in Subiri respondents associated disease endemic to chock and stagnant waters in the community, poor disposal of waste, farming within the surrounding of the community and others. Major diseases prevalent in Akoti include malaria, skin disease, diarrhoea, respiratory tract infection, eye problems, cold and catarrh, fever and Subiri recorded malaria, diarrhoea, cold and catarrh, fever, dysentery etc.

Under polluting of water bodies using chemicals such as mercury, cyanide, zinc etc. a focus group discussion was held with the mining and health workers to come out with its related diseases such as malaria, diarrhoea, bilharzia and skin diseases. When the water bodies are polluted with these chemicals, it can lead to diseases such as malaria, diarrhoea, bilharzia which is contacted through swimming in polluted water bodies and others. It was also revealed that blasting of rocks causes injuries, emits dust into the atmosphere which may also lead to respiratory tract infection, cold and catarrh. It was also observed that, the presence of tailing dams and stagnant cause diseases such as malaria, fever, diarrhoea etc.

A focused group discussion was held with the health workers and observation to come out with the various environmental factors such as chocken and stagnant waters, poor disposal of waste, animal droppings as well as changes in the wealth condition. However, these factors are associated with diseases such as malaria, diarrhoea, fever, skin diseases, biharzia and others.

The health framework (Figure 3), explains how mining related environmental factors and other environmental factors cause diseases and its associated effects in both Akoti and Subiri. In Akoti the mining related environmental factors such as pollution of water bodies by chemicals, tailing dams, blasting of rocks by dynamite and stagnant waters which cause diseases such as malaria, bilharzia, cold and catarrh, skin diseases, injuries, and respiratory diseases. Other environmental factors such as chock and stagnant waters, poor disposal of waste, animal droppings and changes in weather conditions in Subiri also brings about diseases which include diarrhoea, malaria, bilharzia and skin diseases.

The (Table 10), compares the prevalent diseases in both Akoti (mining community) and Subiri (non-mining community). In Akoti, out of the seventy-seven

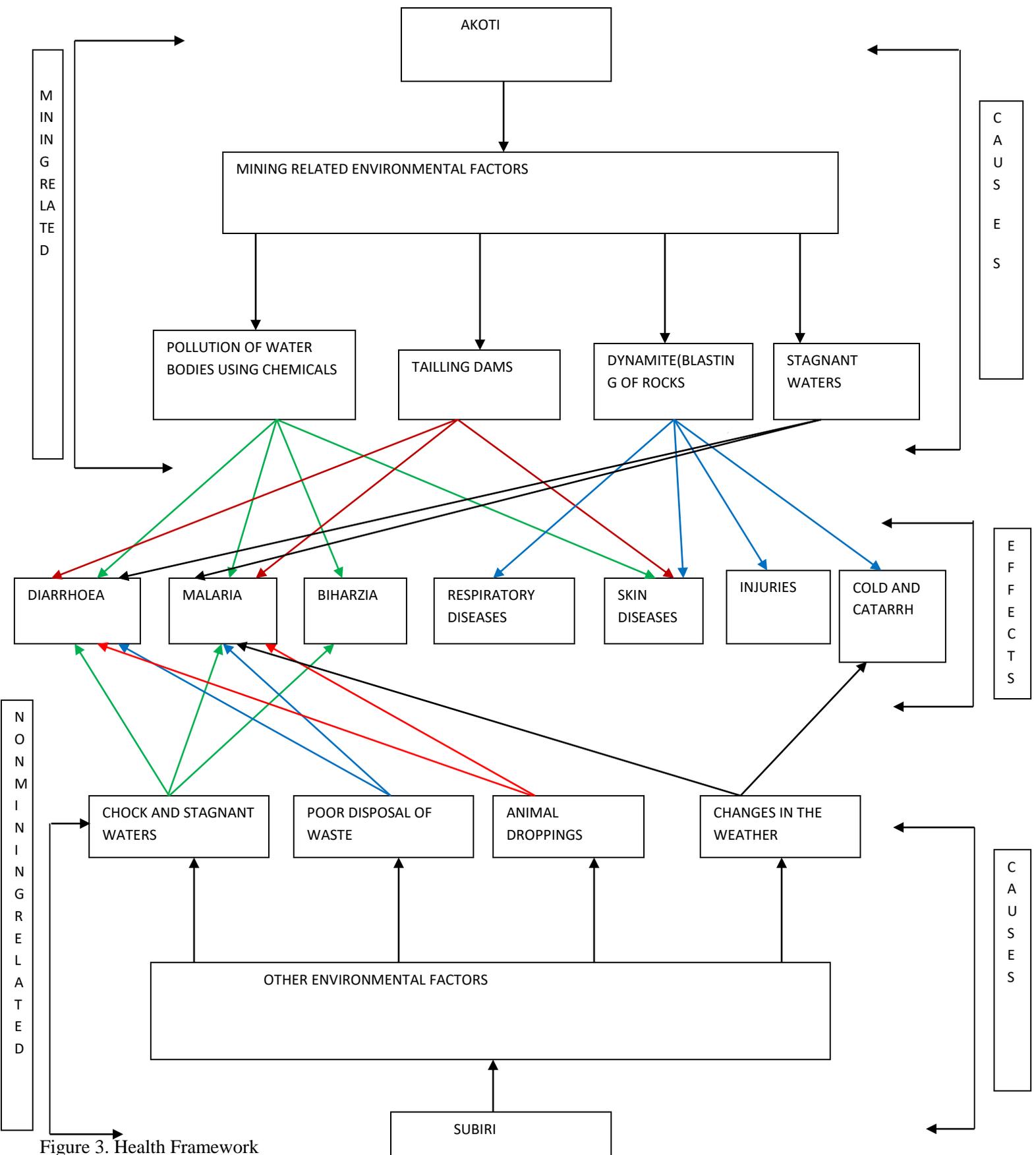


Figure 3. Health Framework

Table 11. Comparing the top ten diseases prevalent in both Akoti and Subiri for the years 2005 and 2012

AKOTI		SUBIRI	
DISEASES		DISEASES	
2005	2012	2005	2012
Malaria	Malaria	Malaria	Malaria
Diarrhoea	Respiratory disease	Fever	Diarrhoea
Fever	Skin disease	Diarrhoea	Abdominal pain
Rheumatism	Colds and Catarrh	Hypertension	Rheumatism
Anaemia	Acute eye infection	Gonorrhoea	Skin disease
Hypertension	Intestinal worms	Bilharzia	Hypertension
Diabetes	Anaemia	Rheumatism	Rhinitis
Colds and Catarrh	Bilharzia	Injuries	Fever
Gonorrhea	Fever	Anaemia	Dysentery
Bilharzia	Pregnancy related disease	Shistosomiasis	Cold and Catarrh

Source: Chirano Health Centre and Subiri Health Centre; Outpatient department, 2012.

questionnaires administered, 38 respondents representing 49.35% said that malaria is the most common diseases affecting their households. To support this, The Ghana Demographic Health Services (2003) made it clear that malaria continue to be the number one killer disease in Ghana especially among infants and nursing mothers in most mining communities. This according to most respondents in Akoti is as a result of improper management of hazardous chemicals, ore processing and improper environmental practices that creates conducive environments for the breeding of mosquitoes in Akoti. The second most prevalent disease in Akoti is cold and catarrh representing 28.87%, fever 6.49%, skin disease 5.19%, chest pain 5.19%, eye and heart problem 2.5% and diarrhoea 1.29% respectively.

Also in Subiri, out of the seventy-nine questionnaires administered, 41 respondents representing 51.89% said malaria is the most prevalent disease in the community. The second prevalent disease is fever representing 27.84%, diarrhoea 8.86%, skin disease 6.32%, cold and catarrh 3.79%, and injuries 1.29%. Respondents gave the following reasons as causing the above numerous diseases; poor disposal of waste, chock and stagnant waters in the community, regular farming at the back of houses and animal dropping could serve as breeding grounds for the mosquitoes, changes in the weather condition could also cause skin disease and others.

In conclusion, it could be realized that malaria prevalence in Subiri is greater than what was recorded in

Akoti from the (Table 10) due to the malaria control intervention by the Chirano mining company in controlling malaria prevalent in the community (Akoti).

The situation as recorded from respondents in the sample communities (Akoti and Subiri) as to how the mining has impacted on their health and the common diseases prevalent was compared with biostatistics data obtained from Chirano health centre and Subiri health centre.

(Table 11), compares the top ten diseases of the outpatient department attendance of both Akoti and Subiri in 2005 and 2012. From the Chirano health centre in Akoti it was evident that malaria, respiratory infection and skin diseases were the top three diseases in the mining community. It is therefore undisputable that the prevalence of these diseases is as a result of pollution of water bodies in the catchment area of the company. To confirm this, seven (7) Chirano health workers including medical assistants and nurses interviewed at the clinic agreed that high prevalence rate of malaria, skin diseases and cough or cold among patients were the effects of mining activities in the community. It can therefore be indicated that high prevalence of malaria in Akoti can be attributed to mosquito breeding from polluted water courses, tailing dams and other stagnant waters collected in holes and pits that are created as a result of mining activities as was evident in responses of respondents. Respiratory infections may have also resulted from air pollution which has emanated from dust emission and other chemicals into the air from the mines open pits and processing plants. Skin

Table 12. A table depicting the occupational distribution of the prevalence of malaria in Akoti and Subiri in 2012

COMMUNITIES	AKOTI		SUBIRI	
	NUMBERS	PERCENTAGE	NUMBERS	PERCENTAGE
Farmers	15	39.5	18	43.9
Miners	5	13.2	1	2.4
Traders	8	21.1	10	24.4
Teachers	6	15.8	8	19.5
Health Workers	4	10.5	4	9.8
Total	38	100	41	100

Source: ERS Researcher, Field Survey, 2012.

Table 13. Comparing respondent's choice of medical care in Akoti and Subiri by Gender

SOURCES OF MEDICAL CARE	COMMUNITY			
	AKOTI		SUBIRI	
	Males/Females	%	Males/Females	%
Clinic	60	77.92	45	56.95
Traditional Medicine	4	5.91	5	6.35
Drug store	3	3.89	9	11.39
Hospital	10	12.98	20	25.31
Total	77	100	79	100

Source: ERS Researcher, Field Survey, 2012.

diseases, fever and diarrhoea have also been caused by polluted rivers and other water bodies which are independent upon by residents in Akoti.

From the St Marks Anglican Clinic in Subiri, the malaria and other diseases prevalent was attributed to the unsanitary conditions in the community, choke and stagnant waters, animal droppings, backyard farming and the drainage pattern in the area but not necessary mining activities. Since malaria is the most prevalent disease in both Akoti and Subiri, occupational distribution of malaria cases in all the communities was gathered to augment how mining impact on the people.

From (Table 12), it was clearly indicated by the respondents that the prevalence of malaria were categorically recorded as follows; in Akoti 15 farmers recorded a percentage of 39.5% whiles in Subiri the

farmers were 18 with a percentage of 43.9%. Also in Akoti, the 5 miners recorded 13.2% whiles in Subiri there was only 1 mining worker with 2.4%.

Though malaria was prevalent in both communities (Akoti and Subiri), however the rate of increase of malaria contraction in Subiri was quiet severe than that of Akoti. For instance in Akoti, farmers' recorded 39.5% whiles in Subiri the farmers recorded 43.9% of malaria cases. This is due to the following precautions being undertaken in Akoti by the Chirano mining company.

-Spraying their rooms and surroundings by mosquito insecticides

-Giving out well treated mosquito nets to the inhabitants of Akoti

-Sensitizing the inhabitants of Akoti on how to prevent or control malaria especially by cleaning their surroundings, however these precautions are not practiced in Subiri and this accounts for high rate of malaria in Subiri as evidently tabulated in (Table 12).

(Table 13) indicates a comparison between respondent's choice of medical care in mitigating the health implications of mining in Akoti and Subiri. In Akoti, the table shows that most respondents use modern health facilities since 77.92% patronize clinics followed by hospital with 12.96%, traditional medicine 5.19% and drug store constitute 3.89%. Respondents' main reasons for giving for choice of medical care are that, diseases are well treated at the clinic and hospitals, easy accessibility to modern health facility and the benefit from the national health insurance scheme and Chirano goldmines insurance given to the mining workers. The few who were not patronizing the clinic and the hospitals were constrained by high clinic and hospital bills which they could not afford; others saw drug store delivery the same service as clinics, especially where the sickness is not all that serious. Notwithstanding the high patronage and improvement in the health care delivery, the mortality situation in relation to malaria and other respiratory infections is high while in Subiri 56.95% patronize clinics followed by hospital with 25.31% and traditional medicine with 6.32%. Respondents from Subiri also gave the following reasons as to how they patronize the modern facility; easy accessibility to the facility in the community, the benefits and affordable health insurance scheme. It is therefore imperative that effort needs to be put in place to furnish the clinics with modern drugs in both communities to mitigate the mining implications in Akoti and other factors contributing to diseases endemic in Subiri.

### ***Interventions to Mitigate Health Implications by Chirano Gold Mines in Akoti***

- Malaria control programme
- Spraying of their surroundings and rooms
- Provision of treated mosquito nets to community residents
- Sensitizing the people on how to prevent malaria by cleaning their surroundings
- Nutritional campaign programme
- Education on how to use personal protective equipments (PPE'S) against injuries and skin diseases.
- Free health insurance scheme to the nuclear families of the mining workers.

### **Institutional Management**

Effective management of the environment lies in the effective implementation of policies by institutions mandated to manage the environment and land use in the district. Institutions that play such functions in the district include: the Forestry commission, the minerals commission and Environmental Protection Agency (E.P.A). The basic function of the forestry commission is to manage the country's forest. The commission is supposed to work with the minerals commission on the granting of exploration licenses and mining leases to ensure a balance between forestry mineral extractions. The E.P.A also tries to strike a balance between the demands of the rapid economic growth and the need to protect the country's natural resources and protect the health and welfare of the people ensuring environmentally sound resource extraction. Also the mineral commission is responsible for recommending mineral policy, advising government on mineral matters, reviewing and promoting activities. It generally serves as the conduit between the mining industry and decision making units of government.

It was realized that the rate of population increase in Akoti was faster than that of Subiri which was attributed to the mining and socio-economic activities which serve as a pull factor for people to migrate to the community as compared to Subiri with only socio-economic activities as their major determinants of population increase.

On the other hand, it was revealed that mining related environmental factors such as pollution of waters by chemicals, tailing dams, blasting of rocks by dynamite and stagnant waters cause diseases such as malaria, respiratory tract infection, diarrhea, bilharzia, skin diseases, cold and catarrh, intestine worm, injury while in Subiri other environmental factors such as chock and stagnant waters, poor disposal of waste, backyard farming, animal droppings and changes in the weather condition which cause diseases such as malaria, diarrhea, fever, bilharzias and others with malaria recorded as the highest diseases in both communities.

Also, Nutritional Campaign Programme, education on how to use personal protective equipment against injuries and skin diseases, free health insurance scheme to the miners and malaria control programme such as spraying of their surroundings and rooms, provision of treated mosquito nets to community residents were some of the interventions embarked by the Chirano Gold Mines in Akoti to mitigate health implications in the community.

## SUMMARY AND CONCLUSION

This part presents the summary of the findings. It draws relevant conclusion and makes recommendations that would highlight the population size and health implications of large-scale mining in both mining and non-mining community.

### *Summary of Mining Community and Non-Mining Community*

Generally, mining activities and how they affect population size of an area (community) is an important area worth to research. From the research conducted using the 17 houses in determining the population increase or decrease, it was revealed that, the number of people living in 17 houses in 2005 was 100 and this number increased from 100 to 130 people in 2012. It was also realized that the number of tenants in 17 houses in 2005 increased from 27 to 52 in 2012 in Akoti. In 2005, out of 27 tenants was 4 mining workers, this increased to 31 mining tenants out 52 tenants in 2012.

The presence of lucrative job opportunities in an area has the ability of attracting more people into the area. With the population issues in the non-mining community, the research revealed 288 people in 30 houses in 2005 and this number increased to 307 people in 2012 due to more people locating themselves in the community for farming, trading etc. according to the respondents. To add to this is, in Subiri out of 39 tenants in 2012 was only 3 mining tenants as 36 tenants engaged in other economic activities such as farming, trading, teaching, health workers and pastors. In comparing population's issues in Akoti and Subiri, it can therefore be concluded that mining activities in a community has the ability of increasing the population size in the area.

The research also showed that cost of renting in Akoti has increased significantly since the beginning of the mining activities while cost of renting has also been stable for longer time in Subiri.

Health implication associated with mining activities deserves much attention. The research revealed that, there is high prevalent rate of diseases such as malaria, respiratory infections, (cold and catarrh) and skin diseases among residents which were direct and indirect effects of mining activities. High prevalence of malaria in the area is attributed to mosquito breeding grounds from polluted water courses, tailing dams and other stagnant waters collected in holes and pits that are created as a result of mining activities in Akoti.

Respiratory infection (cold and catarrh) have resulted from air pollution which has emanated from emission of dust and other chemicals into the air. Skin diseases, fever and diarrhea have been caused by polluted rivers and other water bodies which are depended upon by residents in the community. Throughout the study, it was established that prevalent rate of diseases in the community such as malaria, respiratory infections (cold and catarrh) and skin diseases decreases as one move further away from the mining site. It was also noted that high patronage of the respondents to the modern facilities (clinics) has also played a role in reducing the otherwise negative implication of the mining activity in the area while in Subiri the research revealed the prevalent of the following diseases in the community; malaria, diarrhoea, skin diseases, fever, cold and catarrh etc. Respondents gave the following reasons for the diseases endemic in the community; poor disposal of waste, chock and stagnant waters in the community, regular farming at the back of houses and animals dropping that could serve as a breeding ground for mosquitoes and changes in the weather conditions etc. It was also realized that respondents patronize modern health facilities such as clinic and hospital in the community.

In as much as we know the economic benefit of mining activities in the country, there is the need also to acknowledge the population size and health implications that come with it in order to find ways of dealing with them. This was the main focus of the research. After thorough research into the problems as existed in Akoti and its surroundings, the area of operation of Chirano goldmine limited, population size was observed to be increasing based on the research conducted in the community especially Akoti as a result of mining activities. To add to the above, it was realized that in-migration outweigh out-migration in the district especially in the mining community which Akoti is no exception, according to the medium term development plan of the district in 2010, while in the non-mining community population related issues increase due to people locating themselves in the community for farming, trading etc.

In Akoti, it has come to light that mining activities have resulted in the creation of polluted water course, tailing dams and other stagnant waters collected in holes and pits serves as breeding grounds for mosquitoes. There is also the incidence of air pollution which emanate from emission of dust and other chemicals into the air. The combined effects of the above problems have resulted into health related problems with high prevalence of diseases such as malaria, respiratory tract infections, skin diseases, diarrhea

and fever endemic in the community. There was also indirect effect of mining activities on food production in the community. Diseases endemic was observed not to relate to mining activities alone but also due to poor disposal of waste, chock and stagnant waters, farming in the community surroundings, animal droppings and changes in the weather condition whiles health related issues and the disease endemic in the non-mining community(Subiri) was attributed to poor disposal of waste, chock and stagnant waters, farming in the community surrounding, animal droppings, changes in the weather and regular rainfall within the forest vegetation type in the community.

### Recommendations

Based on the findings, the following recommendations are made to help the stakeholders to improve their services and also fulfill the main objectives in mitigating population size and health implications of sustainable development.

The government of Ghana, who holds rights to all minerals in trust for all Ghanaians, in collaboration with the mineral commission, should make conscious effort to reduce the rate at which lands or concessions are granted to mining companies in the country. This is necessary because despite severe efforts and measures put in place, population size and health implications of mining activities continues to remain a huge difficult situation, particularly to those living in the catchment communities and to a greater extent the country as a whole.

Individuals and households in the community should be sensitized on the need to use mosquito nets in their rooms to avoid malaria infections through biting by mosquitoes.

There should be regular watering and spraying of the community to reduce dust emitted from the mines site into the atmosphere causing diseases which are related to respiratory tract infections.

There is also the need for an effective collaboration and coordination among governmental agencies such as the Environmental Protection Agency(E.P.A), the Ghana Minerals commission, the Forestry commission, the district assembly and others so that they can perform their roles effectively in dealing with population size and health implications associated with mining activities in the community.

The Chirano gold mines and other governmental institutions like ministry of local government and rural development and real estate developers could collaborate to embark on affordable housing programme in the community to accommodate both mining workers and in

migrants. This will help to reduce pressure on the people especially cost of renting.

The Chirano goldmines limited should encourage capital intensive more than labor intensive in order to reduce the number of workers in the company to control population in the community.

The Chirano goldmines needs to revise its social co-operate responsibilities periodically to know the timely need of the community in terms of social amenities such as portable water, market, community centers, parks, toilet, electricity, health post etc. this will help to reduce pressure on the existing social amenities in the community.

### Conflict of interest

Authors have none to declare

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**APPENDIX**

**UNIVERSITY FOR DEVELOPMENT STUDIES  
 FACULTY OF INTEGRATED DEVELOPMENT STUDIES  
 DEPARTMENT OF ENVIRONMENT AND RESOURCE STUDIES**

TOPIC: Population size and Health Implications of Large-scale Mining at Bibiani-Ahwiaso-Bekwai District: A comparative study in Akoti (Mining community) and Subri (Non-Mining community).

This research work is being under taken by a group of students from the University for Development Studies. Faculty of Integrated Development Studies. Department of Environment and Resource Studies. The study is towards the partial fulfillment of the award of Bachelor of Art (Integrated Development Studies) degree by the University. Please answer the questions in candid opinion and be assured that your responses will be treated confidentially.

Questionnaire Number.....

Date.....2012

Name of the researcher(s) .....

**QUESTIONNAIRES SCHEDULE FOR RESIDENTS IN THE SURROUDINGS COMMUNITIES.**

**A. Personal Information**

- 1. Residence .....
- 2. Sex.....Male [ ] Female [ ]
- 3. Age..... 4. Occupation.....
- 5. Marital Status: a. Married [ ] b .single [ ] c. Divorced [ ]
- 6. Highest level of Educational attainment a. Illiterate [ ] b. Basic [ ] c. Secondary (S.S.S, Vocational) [ ] c. Tertiary (Polytechnic, Training college, University) [ ] e. Others, Specify.....
- 7. For how long have you been staying in this community?.....

**B. Mining and Health**

- 8. Do you have any mining company in your community? Yes [ ] No [ ]
- 9. Which of the following diseases do you usually suffer from or contract? a. Malaria b. Diarrhoea c. Skin diseases d. Fever e. Colds and catarrh f. Other disease(s).....
- 10. What diseases do people in your family frequently contract? a. Malaria b. Diarrhoea c. Skin diseases d. Fever e. Colds and catarrh f. Other(s) diseases.....

11. Would you say the disease(s) chosen above are related to the mining activities Yes [ ] No [ ]
12. What are the source of medicine to address your health needs? a. Clinics b. Hospital C. Traditional(herbal) medicine d. Drug stores e. Other(s), Specify.....
13. Give reasons for your answer in question 11 above.  
.....
14. Is Chirano Gold Mines doing anything to address the health needs of your community. Yes[ ] No [ ]
15. If yes, what are some of these activities?  
.....
16. Has Chirano Gold Mines built any health facility in this community for the service of people in the community?  
Yes [ ] No [ ]
17. Does Chirano Goldmines carry out any health campaign programme to educate people in the community?  
Yes [ ] No [ ]
18. If yes, give any example of such campaigns you know of.....
- C.Roles of legal regulating agencies and others stakeholder organization within the mining sector
19. Do you have any idea of agencies or organizations that hold stake in monitoring, regulating and addressing the activities of the mining sector in the district.  
Yes [ ] No [ ]
20. If yes, what are are some of them?(Tick all that apply) a. EPA b.Chamber of Mines c. Ghana Minerals Commission d.N.G.O's  
e. Other(s), Specify.....
21. Do you often hear of any of the above organizations activities relating to mining activities in the town? Yes [ ] No [ ]
22. If yes, which of them do you usually hear of a. EPA B. Chamber of Mines c. Ghana Minerals Commission d. NGOs(Name).....  
e. Other(s),Specify.....
23. Would you say that these(any of them) agencies and organizations are doing well in monitoring and regulating mining activities in the community. Yes[ ] No[ ]
24. Give reasons for your answer to question 22 above.....

25. Do you think the methods of operation by the mining company have some effects on the human environment? Yes[ ] No[ ]

26. Has the cost of renting in the community increase due to the mining activities. Yes [ ] No [ ]

27. if yes, give reason(s).....

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Questionnaire Number.....

Date.....2012

Name of the researcher(s) .....

**INSTITUTIONAL QUESTIONNAIRE  
QUESTIONNAIRE SCHEDULE FOR HEALTH WORKERS**

Personal Information

1.Workplace(Name of clinics/hospital).....

2.Sex.....Male[ ] Female

3.Department/Position.....

4.Which of the following diseases/incidence are frequently reported and diagnosed at the Hospital/clinic?(Tick all that apply) a. Malaria b. Diarrhoea c. Skin disease d. Fever e. Colds and catarrh f. Injuries g. Other disease(s), specify.....

5.Which of the diseases/incidence mentioned above tops the charts for the past four years? a. Malaria b. Diarrhoea c. Skin diseases d. Fever e. Colds and catarrh f. Injuries g. others, specify.....

6.Are some of the diseases directly or indirectly associated with mining activities? Yes[ ] No[ ]

7.If yes, which of the diseases are caused by or associated with the mining activities within the district, specify.....

8. Do the diseases mentioned in question 5 constitute a significant cause in mortality rates in the communities. Yes [ ] No [ ]

9. Is your clinic/hospital fully equipped to handle such cases frequently reported at the hospital/clinic? Yes [ ] No [ ]

10. If no, what are the constraints?.....

11. Is the health sector doing anything possible to address the health problems associated with mining activities within the district? Yes [ ] No [ ].

12. If yes, what are some of the measures.....

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Questionnaire Number.....

Date.....2012

Name of the researcher(s) .....

Questionnaire for landlords/Household

Mining and Population

Personal information

Residence.....

Sex..... Male [ ] Female [ ]

Age ..... 4. Occupation.....

Marital status a. Married [ ] b. Single [ ] c. Divorced.[ ]

What is the total number of people in your house in 2005?.....

What is the total number of people in your house in 2012?.....

How many of the tenants are in your house? a. One b. two c. three d. more than three, specify.....

How many of the tenants in your house are mining workers.....

How many other social/economic workers apart from mining workers rents in your house, specify.....

In your candid opinion, has the mining activity attracted other people into the community. Yes[ ] No [ ]

If yes, give your reason(s).....

In your own opinion, do you think other cultural factors/practices account for increase in population in the community. Yes [ ] No [ ]

If yes, specify.....

What was the cost of renting a room in your house in 2005?, specify.....

Has the cost of renting increase/decrease in 2012. Yes [ ] No [ ]

If yes, give reason(s).....

**UNIVERSITY FOR DEVELOPMENT STUDIES  
FACULTY OF INTEGRATED DEVELOPMENT STUDIES  
DEPARTMENT OF ENVIRONMENT AND RESOURCE STUDIES**

TOPIC: Population size and Health Implications of Large-scale Mining at Bibiani-Ahwiaso-Bekwai District: A comparative study in Akoti (Mining community) and Subri (Non-Mining community).

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Questionnaire Number.....

Date.....2012

Name of the researcher(s) .....

Institutional questionnaire

Questionnaire Schedule for Workers of Chirano Goldmines

Personal Information

Residence.....

Sex.....

Department.....

### Mining and Population Growth

Are you a native of this community? Yes [ ] No [ ]

Do you reside in the community (Akoti). Yes [ ] No [ ]

If yes, specify the size of your nuclear family (if they are residing in the community).....

In your candid opinion, has the mining activity attracted other sub-mining company's workers into the community? Yes [ ] No [ ]

If yes, specify the sub company you know.....

Does this sub company's worker normally reside in the community? Yes [ ] No [ ]

### Mining and Health

Which of the following diseases do you

Usually suffer from or contract? a. malaria b. Tuberculosis c. Colds and Catarrh d. Skin disease

Would you say the disease(s) chosen are related to the mining activities? Yes [ ] No [ ]

What are the sources of medicine to address your health needs? a. Drug stores b. Clinics c. Hospitals d. Traditional(herbal) medicine e. others, specify.....

What method of extraction is/are used by the company? a. Surface mining b. Underground c. Dredging d. Gallamsey method e. others,.....

Do you think the methods of operation by the mining company have some effects on the health of the workers? Yes [ ] No [ ]

If yes, what are some of the effects? a. Tuberculosis b. Malaria c. Asthma d. Cold e. others, specify.....

Do the operations of the mining company involve the use of heavy equipment/machines? Yes [ ] No [ ]

If yes, specify the health related effects on the workers.....

### Intervention

Does Chirano Goldmines carry-out any health campaigns programmes to educate people in the community? Yes [ ] No [ ]

If yes, give example of such campaigns you know of.....

Has Chirano Goldmines built any health facility in this community for the services of workers and the community? Yes [ ] No [ ]

Does Chirano Goldmines give scholarship to both workers and student to further their studies especially medicines. Yes [ ] No [ ]

22. If yes, how many people/workers and students do they sponsor a year.....