

Research Article

Artisanal Mining and Its Ramifications on the People of Prestea

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Abstract: This research aims at outlining the various effects of artisanal mining on the Prestea community in Ghana, measures adopted to minimize these effects as well as recommendations and the way forward. Artisanal mining is a worldwide phenomenon and Ghana is no exception. Prestea is a community endowed with gold and located in the Western Region of Ghana. In view of this many people engage in artisanal mining to extract the gold deposits which bring them lots of monetary benefits. However, their activities have posed great threat to the society, the environment and the economic growth of the community. This research adopted purely a qualitative approach of data collection as well as analysis and reporting in an effort to outline the socio-economic effects of the activities of artisanal mining in the community. It is evident that, though artisanal mining provides high incomes directly to those engaged in it and indirectly to those in the commerce and agriculture sector, the subsector wreaks havoc on the environment, the society, economy and the health of the community. Though some efforts have been made by the Traditional Authority in the Prestea community and the Town Council by organizing sensitization programmes on the dangers of artisanal mining to the community as a whole, there has been no significant improvement.

Keywords: Artisanal mining, galamsey, gold, Ghana, river ankobra, prestea

INTRODUCTION

Artisanal mining in many parts of the world plays an important role particularly with respect to the employment opportunities it offers. According to Veiga and Hinton (2002), the term artisanal mining seems to best encompass all definitions and designations, as it includes all small, medium, large, informal, legal and illegal miners who use rudimentary processes to extract gold from secondary and primary ore (Veiga and Hinton, 2002). Also, Hentschel *et al.* (2002) defined artisanal mining as mining by individuals, groups, families or cooperatives with minimal or no mechanisation, often in the informal (illegal) sector of the market. Hentschel *et al.* (2002) and Hilson (2002a) also defined artisanal mining as a mining activity which involves the application of low, intermediate technology and universal prospecting methods and requiring low initial investments and high employment per-unit output.

Broadly speaking, artisanal mining companies are generally those mining companies that employ poorly trained people and involve the use of low level of technology. Artisanal mining plays a very important role in poverty alleviation in rural development programmes. As a result of this, most developing countries including Ghana have resorted to improving

the sub-sector so as to reduce poverty. In a research study by Amankwah and Anim-Sackey (2004) on Small scale mining, they posit that due to the sub-sector's labour intensity, artisanal mining operations generally generate significant employment avenues, especially in remote rural areas where alternative job opportunities are scarce and low paying and apart from the sub-sector directly employing many also generates a substantial number of indirect jobs in other sectors of the economy (Amankwah and Anim-Sackey, 2004). However, the sector is well-known for its high environmental and sanitation costs and poor health and safety record. Described by Hentschel *et al.* (2002), in the Global Report on Artisanal and Small-Scale Mining, the sector is viewed by many as dirty, unprofitable and basically unsustainable (Hentschel *et al.*, 2002).

"Galamsey" on the other hand has been a long standing activity. Nevertheless, the name was initially coined from how it was organised (Samuel *et al.*, 2012). Initially, the indigenous people just gathered the gold and sold it to their foreign counterparts. Overtime, "the gather and sell" transactions was corrupted as "galamsey." In recent times, the term "galamsey" refers to four major groups of miners including; those who do not have mining license to operate, people who have mining licenses but are using unapproved tools and equipment to undertake deep mining, as well as those who had licenses to operate but failed to reclaim the

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degraded land after extensive environmental degradation and people who sub-leased their mining licenses to foreigners to do small-scale mining (Ibid).

In spite of the perspective of whether or not the sub-sector is dirty, unprofitable and basically unsustainable, the fact remains that, artisanal mining activities will continue for as long as poverty continues to prevail. It is therefore significant that attention is paid to the sub-sector to maximize the benefits (Hentschel *et al.*, 2002). On the global scale, artisanal mining has contributed tremendously to the development of the wellbeing of the communities and countries directly involved in the sub-sector. The sub-sector has played one of the leading roles in the provision of employment and income to individuals who dwell in communities with these natural resource potentials. Reference from the Global Report on artisanal and small-scale mining by Hentschel *et al.* (2002) outlined that, artisanal mining has employed over (13 million) people globally and that about two hundred thousand people are employed in the sub-sector in Ghana with women and children inclusive (Ibid). Like all other nations which engage in artisanal mining, Ghana has benefited from the sector in some aspects of human and community development. Despite the benefits gained from the mining industry, the sector is challenged with many political, environmental, health and socio-economic problems among others.

The Global Report on artisanal and small-scale mining explained that, the challenges faced by the sub-sector create uncontrollable chaos within the system in terms of physical and non-physical development of the environment and the individuals engaged in it (Ibid). This study explores artisanal mining activities undertaken within the country, the various methods used in artisanal mining as well as the threats it poses. The study draws valid conclusions on whether artisanal mining has adverse impacts on our land and water resources with much focus on Prestea in the Western Region of Ghana. Though the sector is viewed by the "Global Report on Artisanal and Small Scale Mining" as dirty, unprofitable and basically unsustainable, there is the need to assess the statement as to why the sub-sector is dirty, unprofitable and basically unsustainable (Ibid).

The production of gold has been one of the major avenues in the quest for living in the Prestea community. The local people resort to the sector as one of their main source of employment. Prestea abounds with mineral resources particularly gold. As a result of this, large scale firms have established their operations in the community. Through this, these firms do employ the local people. However, due to the inability of these large scale firms to employ all the people of Prestea coupled with few employment opportunities, they, the unemployed in the community resort to artisanal mining as their only alternative for livelihood.

In spite of the fact that, the sub-sector is very lucrative, there are hazards which pose great threats to the community and the artisanal miners. Several

studies in environmental and sociological impact assessment have been done to assess the impact of artisanal mining on Ghanaian societies. It is therefore essential to do a historical study on the operations of artisanal miners and their associated impacts on the Prestea community in particular.

MATERIALS AND METHODS

This section outlines the processes and techniques used to collect data for this research. It also discusses the research design, the target population, the sample and sampling technique used in the research. It also takes into consideration the instruments used for data collection and the procedures for the analysis of the research data.

Severally, qualitative methods have been used in this study with some quantitative approach. As a case study, data was collected and analyzed from questionnaires administered to a segment of the entire population of Prestea. The focus was mainly on the operations of artisanal miners in the area. This design enabled the researchers to explore and solicit various opinions, perceptions and ideas of people with respect to the impacts that artisanal mining have on the study area. Also, other tools adopted are focused group discussions, personal observation and information from key informants and opinion leaders. These were done to investigate the contemporary phenomenon and analyze them into the real life situation which will helped in drawing clear boundaries between the phenomenon and the context in which the phenomenon operates.

The literature on artisanal mining and definitional issues: According to Hinton artisanal mining refers to the informal activities carried out using low technology or with minimal machinery (Veiga and Hinton, 2002). Shoko and Love (2005) cited by Adomaah-Basseah (2011) also explained artisanal mining as a term used to describe mining activities that uses simple methods (e.g., pick, chisels, sluices and pans) to extract and process gold on a small scale (Shoko and Love, 2005).

Shoko and Love (2005) described artisanal mining as subsistence, those engaged in it work independently using their own resources. He further argued that although the subsector is described as being individualistic and not corporate, nonetheless the subsector includes enterprises or individuals that employ workers for mining but generally working with hand tools other than heavy machinery. He then said that the subsector is also characterized by a labour force that is not formally trained in mining, prospecting, extracting and processing of minerals (Ibid).

According to Hentschel *et al.* (2002) there has not been an accepted definition for artisanal mining. In view of this artisanal mining is often characterized by some key features. Hentschel *et al.* (2002) then outlined some characteristics of artisanal mining which include: lack or reduced degree of mechanization, great amount of physically demanding work; low level of

occupational safety and health care; deficient qualification of the personnel on all levels of the operation, inefficiency in the exploitation and processing of the mineral production (low recovery of values). The others include exploitation of marginal and/or very small deposits, which are not economically exploitable by mechanized mining, low level of productivity, low level of salaries and income, periodical operation by local peasants or according to the market price development, lack of social security; insufficient consideration of environmental issues, lack of working and investment capital and mostly working without legal mining titles (Hentschel *et al.*, 2002). In view of this, artisanal mining has been defined in this study as mining by individuals, group of people, or a corporation that mine for precious minerals using minimum specifications on a small piece of land including rivers and often on illegal basis.

Historical background of artisanal mining:

According to Hilson (2001), history of artisanal mining in Ghana dates far back about 2000 years ago and that traces of alluvial gold mining and mining activities have been found that date as far back to the 6th century (Hilson, 2001). In his book "Harvesting mineral riches": 1000 years of gold mining in Ghana, Hilson (2002b) said traces have been found that there is a wealth of evidence indicating that precious metals recovered from regional artisan activities were attracting Arab traders to certain areas of the country as early as the 7th and 8th centuries AD. It was due to the rich gold deposits of the coasts of Western Sahara that were largely responsible for the wealth and strength of large ancient Ghanaian empires and cultures. So therefore, it was befitting for Ghana to be tagged as the "Gold Coast" in the 15th and 16th centuries by the Europeans.

For decades, artisanal mining in Ghana was treated as an informal industrial sector which employs thousands of people. Although the sector is responsible for employing thousands of people, it has featured largely rudimentary, unmonitored and uncontrolled practices.

Artisanal mining in Ghana remained unregulated and received meager support from the government in that the sector was largely unregulated. However, things changed when the government as in the 1980s implemented the Economic Recovery Programme (ERP). This programme factored in the plans to revitalize the stagnating economy of the country as in the mid 1980s. Through these plans, the then government (Provisional National Defense Council, PNDC) sought economic assistance from the World Bank and the International Monetary Fund, IMF to assist in the drafting of the National Economic Plans and Policies. One strategy to revitalize the artisanal mining was to promote foreign investment. In this strategy, series of tax breaks and benefits were offered

to foreign investors seeking to acquire mineral prospecting licenses in Ghana (Ragnar, 2005).

With regards to the ERP by the PNDC, the small scale mining subsector of the mining industry was heavily targeted and for the first time in the history of Ghana, government discussed plans to formalize the sector. This was done after the government identified the potential earnings in the industry. Therefore, by the end of the 1980s, the government had then fully regularized the artisanal mining sector through a series of policies and regulations (Ibid).

Geological setting of artisanal mining in Ghana: For artisanal and large scale mining to flourish in a region, it largely depends on the favorable geological setting. Ghana is situated within the West African Craton, which stabilized about two billion years ago during the Proterozoic Era where large areas were folded, faulted, metamorphosed and subjected to igneous activity, erosion and sedimentary processes, gave rise to series of gold belts.

Ghana is covered by the Paleoproterozoic rocks of the Birimian gold and the Tarkwaian gold which are the two forms of gold deposits found in the country. As a result of series of erosional events, significant portions of these rocks have been redeposited in the rivers and streams in the country. These gold deposits in the rivers and streams, also known as alluvial gold, are found in majority of rivers that drain Birimian and Tarkwaian gold deposits and occur along the terraces, floodplains, channels and river beds of Offin, Pra, Ankobra, Birim and Tano rivers. Therefore, it is not strange that the indigenes undertake artisanal mining activities at the basins of these rivers.

Prestea community falls along the river Ankobra. This river is one of the numerous rivers which drain the Birimian and Tarkwaian rocks containing gold deposits. Despite large deposits of gold found in the rivers and along the basins of rivers that drain Birimian and Tarkwaian rocks, there are other places in the country that people do engage in artisanal mining of precious minerals where these rivers do not pass. These places are endowed with the Birimian and Tarkwaian rocks which contain gold deposits and other precious minerals. One typical place is Obuasi where the people have to bore deep in the mountains to extract these precious minerals particularly gold.

Methods of artisanal mining: According to Aryee, artisanal miners in Ghana employ various methods in their operations according to the type of deposit being exploited and its location. He further argued that a large majority of artisanal miners rely solely on traditional/manual methods of mining which features simple equipment like shovels, pick-axes, pans, chisels and hammers. Aryee *et al.* (2002) then identified and grouped these methods into three types which are

shallow, deep and hard rock alluvial mining (Aryee *et al.*, 2002).

Shallow alluvial mining: Aryee argued that shallow alluvial mining method (popularly known as dig and wash) is used to mine shallow alluvial deposits which are usually found in valleys or low lying areas. These deposits are small traces of precious minerals that have depths not exceeding three meters. He said that with regards to this, the vegetation cover has to be initially cleared and the soil excavated until the gold-rich layer is reached. The mineralized material is removed and transported to nearby streams for sluicing to recover the gold.

Deep alluvial mining: This method of small scale mining of precious minerals are used to mine deep alluvial deposits found along the banks of major rivers in Ghana such as Ankobra, Tano and Offin. Deep alluvial mining involve excavating a pit and digging deep until the gold bearing gravel horizon which is typically 7 to 12 m deep is reached. In the application of this method of small scale mining, terraces are constructed along the sides of pits. This is mainly done to prevent collapse. The gold bearing gravel is then removed and sluiced to recover the gold.

Hard rock (Lode) mining: This technique is adapted to mine gold bearing reefs which can be located close to the surface or deep-seated. Holes are sunk to intercept the reefs and when accomplished, the reefs are worked along the strike. Where the reefs are weathered, small scale miners use chisels and hammers to break the ore containing the precious mineral. Explosives are used in cases where the ore is hard (Ibid).

Legal regulations governing artisanal mining in Ghana: According to Hilson (2001) small scale gold mining in Ghana, as in most developing countries, was for decades treated as an informal industrial sector which employs thousands of people but uses largely rudimentary, unmonitored and unrestrained practices. He further explained that until the 1980s, small scale gold mining activities in Ghana remained largely unregulated and received little support from governmental bodies. He argued that with the implementation of the legal framework for registration of small scale gold and diamond mining, the sector has seen tremendous transformation (Ibid). Anon also argued that with the implementation of the Small Scale Mining Law under PNDC Law 281, led to the institution of the Small Scale Project with the Ghana Minerals Commission which has the responsibility of providing technical assistance to prospective and registered small scale miners in the country. Under the PNDC the 1980s saw another regulation regarding the use of mercury in small scale mining. The Mercury Law, PNDCL 219 (Anon, 1989c) legalized the

purchasing of mercury for gold recovery purposes from authorized dealers (Anon, 1989b). Also the Precious Minerals Marketing Corporation (PMMC) Law, PNDCL 219 (Anon, 1989a) created an authority to buy and sell gold and diamonds.

Anon further argued that since the inception of these legal regulations governing small scale mining in Ghana, two types of small scale miners have emerged which are legal small scale miners and illegal small scale miners. Legal small scale miners are the ones who have acquired mining licenses from the Minerals Commission of Ghana to cover their concessions. The law mandates, an area of 25 acres is the maximum allowable area that is allocated to each person or group of persons as a concession. The other groups which are the illegal small scale miners are the ones who do not operate with a given permit (Ibid).

Effects of artisanal mining on operational communities: According to Hilson (2001), the effects of Artisanal mining can be grouped into two, which are the social/environmental and the economic effects. He argued that the social/environmental effects relate to the human society and the inhabitants of the human society while the environmental effects highlight on the effects in relation to the external conditions of the society which include land, water bodies, among others. On the other hand, the economic effects relate the Artisanal mining activities in relation to the economy, the system of production and the management of material wealth.

Social and environmental effects of artisanal mining:

Land degradation: Akabza and Dramani, cited by Besseah (2011) argued that as artisanal miners operate, the vegetation cover is naturally cleared. Since land is the main source of livelihood of the people, artisanal mining tends to create crucial adverse effects on the people within areas where the activities are predominant. There is therefore deterioration in the viability of the land for agriculture purposes and loss of habitat for micro and macro organisms.

Artisanal mining also tends to create significant damage to landscapes. As a nomadic industry, workers abandon pits and trenches without properly reclaiming tends. Hilson (2001) therefore explained that, it is quite common to identify potholes which are devoid of vegetation cover after periods of intensive prospecting.

Deforestation: Hilson (2001) explained that one main factor that leads to rapid urbanization is the emergence of overnight settlements in newly discovered mining areas (particularly gold). This in form creates a messy settlement which do not only end up in rampant deforestation, but also creates social vices associated with urbanization which include drug abuse, prostitution, land use conflicts with local communities,

as well as water pollution, child labour and diseases (Ibid). He further argued that as the settlements grow, inhabitants build structures for shelter and in the process, log down trees without replacing them. As this activity goes on bit by bit, trees perish leaving the bare land to the mercy of the sun. Also, the exuberant consumption of wood for charcoal as a source of energy gradually results in the depletion of the biodiversity of trees thereby increasing the rate of desertification. (Ibid)

Pollution of water bodies: Cifuentes and Rodriguez (2005) described water pollution as a naturally induced change in the water quality or conditions induced directly by man's activities which render it unbefitting for food, human health, industry, agriculture or pursuit of leisure. In the process of mining, artisanal miners resort to these water bodies as their only remedy for dumping their toxic waste (Cifuentes and Rodriguez, 2005). Cifuentes and Rodriguez explained further that these toxic chemicals dumped in the water bodies pose a great threat to the safety of drinking water. Their effects are gigantic of which can cause damage to the human health and the vegetation cover as well as the aquatic life as well (Ibid).

Besseah (2011) also said that the activities of artisanal mining divert watercourses away from the mining sites. This distorts the natural watercourse which leads to surface water pollution. Water pollution caused by the activities of artisanal mining are mainly in four key areas. This was identified by Crispin (2003) which include, the release of metals, acid rock drainage, siltation and water use.

Air pollution: Cifuentes and Rodriguez (2005) argued that the chemicals used in processing the ore generate lots of toxic gases and fumes which is responsible for diseases relating to the lung such as tuberculosis. Some of the chemicals produce harmful gases through the activities of grinding of the ore (rock), vehicular movement, among others.

Health and safety impacts: According to Besseah (2011) artisanal mining requires handy tools for operation. In view of this, miners' operations are limited to few meters below the ground level. He said that the hand dug tunnels and shafts created by these miners are shallower and smaller than those of the large scale commercial mining companies that have logistical support. This makes them become endangered to the associated problems with pit collapse and landslide. The International Labour Organization (1999) estimated that, there are more than 6,000 deaths that occur in small scale mining each year in Pakistan, China and many other countries. International Labour Organization (1999) also identified some five major health risks associated with small-scale Mining. They include exposure to dust (silicosis), mercury and other chemicals. The others include the effects of noise and vibration, poor ventilation (heat, humidity, lack of

oxygen) and the effects of overexertion, inadequate work space and inappropriate equipment (Ibid).

Economic effects and artisanal mining: The research undertaken by Hentschel *et al.* (2002) revealed that despite the fact that small scale mining has contributed negatively to the development of societies in the social and environmental concerns, the sector has contributed to providing employment to the communities where the activity is done. In a research undertaken by Darby and Lempa (2006), it are estimated that, the sector employs about 13 to twenty (20) million people worldwide and that more than 100 million people rely on the sector for income, mainly in developing nations. The sector has also contributed immensely in providing employment to about 150,000 to 200,000 people in Ghana. Aside the generation of employment to the local people, small scale mining also contributes to increasing the local purchasing power, stimulating local economic growth and also slowing down urban migration. Though a lot have been said about the sector in the negative sense, nevertheless, the sector has produced some positive benefits which contributes to the economic development of societies or communities.

Some topography and history: The name of the study area is Prestea. It is a town in southwest Ghana, in the Western Region and about 50 km north of the coast of the Atlantic Ocean. It lies on the west bank of the Ankobra River, about 60 mL (100 km) northwest of Cape coast. It is part of the Prestea Huni- valley District. Prestea is the forty-eight most populous in Ghana with a population of 35,155 people (2010 Population census).

Since 1873 there has been mining of gold deposits in Prestea and in 1965, independent gold mining companies based in Prestea were merged by the government. The World Bank granted a loan in 1985 to finance gold mining in Prestea, but after three years of continuous losses by the merged gold company, the mines that were privatized from 1994 to 1999 had their mineral rights sold to the Canadian company, Golden Star Resources. The mining of gold caused environmental problems, such as the storage of overburden in the vicinity of the hospital, contamination of the river with toxic waste, as



Fig. 1: Remains of gold ore dumped in anwiam, Prestea after processing; Field survey, January 2015



Fig. 2: Polluted Ankobra River due to artisanal mining activities; Field survey, January 2015

happened in October 2004. Due to the vibrations caused by the explosions, damage was caused to the buildings of the town. The gold mines are a tourist attraction, partly due to the smelter where the gold is melted down into ingots as well as the two tennis courts and an 18-hole golf course (Interview, Nana Nteboa Prah IV, 2015).

History of artisanal gold mining in prestea: Gold mining in Prestea community was mainly on a large scale basis back in the 1960s and 1980s where gold was produced by the mining companies like the Prestea Sankofa Gold Mining Co. Ltd and the Golden Star Resources Co. Ltd. The extraction of gold was mainly deep shaft mining (underground mining) (Interview, Nana Nteboa Prah IV, 2015).

According to Prestea divisional chief, Nana Nteboa Prah (IV) the two companies (Prestea Sankofa Gold Mining Co. Ltd and the Golden Star Resources Co. Ltd) employed over 5000 people who lived in the community as at 1970-1980s (Ibid). These two companies employed most of the inhabitants of the community and as a result, people migrated from other parts of the country to the community (Prestea) which made the population rise massively from 5,143 people in 1970 to 69,221 people in 1984 (Population census reports for 1970 and 1984) (Ghana Statistical Service, 2005).

With time, the mining companies decided to operate not using the deep shaft method, but rather employed the surface mining method of extracting gold with minimal attention to the deep shaft method of extracting gold. As a result of the surface gold mining which is more capital intensive than labour intensive, greater proportion of the employees were laid off from the two companies leaving few people employed who hail from the community (Interview, Nana Nteboa Prah IV), Prestea divisional chief). Due to this, the laid off workers from the companies had to search for other alternative source of livelihood. In search for the alternative source of livelihood, most resorted to finding areas in the community where gold can be mined on small scale. Nana Nteboa Prah (IV), added that, since the community is rich in gold deposits, the laid off workers quickly found their alternative sources of livelihood by engaging in small scale gold mining and hence the birth of “galamsey” in Prestea (Ibid).

Others who could not engage themselves in the small scale mining migrated from the community to find other alternative sources of livelihood in other communities and as such the population dropped drastically. This is evident in the population and housing census conducted in the year 2000 where the population fell from 69,221 people in 1984 to 21,844 people in 2000 – The Population Census Reports for 1984 and 2000 (Ghana Statistical Service, 2005).

Climate and vegetation: The community falls within the South-Western Equatorial Zone and therefore has fairly uniform temperature, ranging between 26°C in August and 30°C in March. Generally, the community has a relative humidity which is high and ranges between 70 and 80% in the dry season and 75 and 80% in the wet season (Ibid). Prestea community falls in the region of Ghana which receives the highest rainfall. The community has a mean annual rainfall of 188 cm with a double maxima rainfall starting from March and September as the main rainfall season and October to February as the dry season (Unimax MacMillan Limited, 2001).

Due to the climate of the area, the environment is affected by the creation of watersheds, large expanses of stagnant water bodies, deep trenches and gullies as well as leaching the nutrients of the soil (Ibid). Vegetation of the community falls within the rainfall belt with the height of trees ranging between 15 m high to 40 m high. Trees in this community have climbers and lianas, which are able to reach into the upper tree layer. Trees which are abundant in the vegetation region are Mahogany, Wawa, Odum, Sapele, Rubber tree, among others.

Mining activities in the community has resulted in changes in weather conditions which sometimes do not depict the general climatic conditions of the geological zone in which the community falls. The temperature sometimes rises high above the normal temperature at certain times in the day due to the degradation of the land and the forest areas. This is mainly due to the mining activities in the community.

Geology and soil: The community forms part of the Birimian and Tarkwain geological formations. The Birimian rocks are regarded economically as the most important formations due to its mineral potentials. This accounts for the existence of many gold mining companies in the community.

Soils are deep and open and acidic in many places in the community due to heavy leaching of bases from the top because of high rainfall, humidity and temperatures (Hayford *et al.*, 2009). They are mainly forest oxysoils developed over a wide range of highly weathered parent rocks including Tarkwaian and Birimian rocks. The acidic nature reduces availability of soil phosphorus, calcium and magnesium, but generally, leaves are acceptable for good plant growth,

hence the existence of the cultivation of cassava, maize, plantain, rubber, cocoa and oil palm, among others (Ibid).

Overview of artisanal mining in prestea community:

Prestea community is one major area where artisanal gold mining is dominant. The operation of artisanal gold mining is done right in the community with respect to the surface and hard rock small scale miners. With respect to those groups who undertake alluvial small scale gold mining, their operations are mainly in the Ankobra River.

Artisanal gold mining is dominant in the community due to the fact that, the geological composition of the soil lies in the Tarkwaian and Birimian region of the nation where precious minerals are in abundance such as gold. Artisanal miners in Prestea normally undertake their activities in a group though on individual basis. That is, though there are no interferences from other groups, there are some sorts of interaction between the groups.

Small-scale mining are in four forms in Prestea community, they are the deep alluvial small scale mining, shallow alluvial small scale mining, hard rock (lode) small scale mining and surface small scale mining.

The artisanal miners who operate the deep and shallow alluvial method operate along the Ankobra River. Those groups and individuals who adopt the hard rock (lode) method of mining operate in the tunnels that have either been built by them or have been abandoned by the mining companies or other artisanal miners. With those artisanal miners who adopt the surface mining method, they perform their activities on mountain and hills which bear the precious mineral. The community is dominated by artisanal mining as one of the major economic ventures which generates employment for the people. Nevertheless, the activity is associated with many environmental, safety and health hazards. One Traditional Council member of Prestea attested to the fact that, the activity has brought chaos to the community and that, there are lots of social vices created as a result of “galamsey” and that the people who engage in the activity are into drug addiction and substance abuse (Interview, Osabarima Kofi Mensah, 2015).

The processing of gold is one important aspect of the artisanal mining operations. For the artisanal miners to obtain gold from their lode there is the need to go through lots of processes. Artisanal miners who operate along the Ankobra River do not bring their raw materials to the community for processing. With respect to the hard rock and surface mining, they bring their raw material to the community for processing. This creates a mess in the community by polluting the environment. Residents do complain a lot about how the small scale miners go about their activities within the community.

The mining companies in Prestea which include Bogoso Gold Co. Ltd. (BGL), Sankofa Gold Mining Co. Ltd and the Golden Star Resources Co. Ltd, together with the traditional authority and the town council had undertaken several sensitization exercises about the dangers of artisanal mining but to no avail. The numbers of people who undertake these activities has been on the increase. This is evident at the Anwiam and Nakaba parts of Prestea.

Figure 1 gives a vivid picture of how lands are being destroyed by artisanal mining. It can be seen that as artisanal miners operate, the vegetation cover is naturally cleared. Since land is the main source of livelihood of the people, artisanal mining tends to create adverse effects on the people within areas where the activities are predominant. There is therefore deterioration in the viability of the land for agriculture purposes and loss of habitat for micro and macro organisms.

Also, Fig. 2 depicts how the water bodies around Prestea are being destroyed. Artisanal miners resort to these water bodies as their only remedy for dumping their toxic waste like organic mercury and cyanides. These toxic chemicals dumped in the water bodies pose a great threat to the safety of drinking water. Their effects are enormous and can cause damage to the human health and the vegetation cover and the aquatic life.

RESULTS AND DISCUSSION

The field survey took place from 3rd February 2015 to 21st February 2015. A total of 40 households and 25 Artisanal Miners were interviewed. In addition, there was an interview with the Traditional Authority, of the area the Town Council, a Concession Owner and two teachers (Prestea Presby Basic School and Prestea Senior High Technical School). Fifteen teachers (5 from the basic school and 10 from the senior high school) were interviewed to give their perception about the economic activity and how the economic activity has affected their life, the environment and their profession. Thirteen students including teachers were also interviewed. The students were mainly senior high school students. Personal observation was another major tool which was used during the field survey.

Age of respondents: The age characteristics of artisanal miners range from 15 to 42 years whereas ages for the households stretch to 60 years and above per the survey. This classification of the ages of the respondents, be it the head households, or the artisanal miners, is done in order to aid the smooth analysis of the data collected from the field survey. The age range for most (80%) respondents who are artisanal miners' is from 18 to 35, whereas the few 20% belong to the minor (8%) and the aged (12%) respectively. This buttress a point which was made by one respondent

who teaches at the Prestea Senior High Technical School, that the venture attracts a majority of the youth regardless of their educational background (Table 1).

The few minorities in the aged class who engage in the venture are in it due to lack of employment avenues in the community and that the venture provides quick money. Children less than 18 years of age represent 8% of the artisanal miners in the community. These children do not see the essence of attaining higher education due to the fact that, the venture is a quick way of attaining fast money. Others responded that, their parents cannot help them to pursue higher education and the best thing they can do for themselves and their families is to engage in artisanal mining which brings income to the family.

On the other hand, things are quite different with regards to the household age characteristics. Whereas 80% (which form the majority) of the total respondents belong to the youthful class, the household heads have their majority in the aged class which amount to 70%. It can therefore be said that, more youth prefer going into artisanal mining as an economic venture. It was

explained by some respondents that, artisanal mining is a venture which brings quick money but kills rapidly. Therefore, the venture is not a permanent venture where one should engage himself or herself in as a permanent job. Hence, one should work in the venture for quite a while, gather money and get another venture. This explains the reason why more youth are into the artisanal mining venture and more aged class in the households. About 43% of the household heads added to the fact that, they were into artisanal mining while they were in their youthful ages but cannot continue while they are old due to the venture demanding more strength for operation.

Educational background of artisanal miners: Educational background refers to the highest level of education achieved by the respondents. The survey revealed that the majority of the artisanal miners (that is 72%) have had basic school as their highest level of education attained and the minority which constitutes 28% have either had no formal education or have

Table 1: Age distribution of household heads and artisanal miners

Age classification of respondents Age group	Artisanal miners			Household heads		
	Frequency	(%)	(%)	Frequency	(%)	(%)
Less than 18	2	8	8	-	-	-
18-20	3	12	80	-	-	30
21-25	5	20		1	2.5	
26-30	8	32		6	15	
31-35	4	16		5	12.5	
36-40	2	8	12	8	20	70
41-45	1	4		7	17.5	
46-50	-	-		6	15	
50-54	-	-		4	10	
55-60	-	-		1	2.5	
61 +	-	-		2	5	
Total	25	100	100	40	100	100

Field survey, February 2015

Table 2: Highest level of formal education of artisanal miners

Item Level of education	Artisanal miners		Households	
	Frequency	Percentage (%)	Frequency	Percentage (%)
Non-formal education	2	8	1	2.5
Basic education	18	72	8	20
Secondary education	5	20	23	57
Tertiary education	-	-	7	17.5
Others (adult education, among others)	-	-	1	2.5
Total	25	100	40	100

Table 3: Age and highest level of education distribution of artisanal mining

Age	Non formal education		Basic education		Secondary education		Tertiary education		Age category
	Frequency	(%)	Frequency	(%)	Frequency	(%)	Frequency	(%)	
17-19	-	8%	5	68%	-	12%	-	-	Youth
20-24	-	-	5	-	-	-	-	-	
25-29	1	-	5	-	2	-	-	-	
30-34	1	-	2	-	1	-	-	-	
35-39	-	-	1	-	1	-	-	-	
40-44	-	-	0	4%	1	8%	-	-	Aged
Total	2	8%	18	72%	5	20%	-	-	

Field survey, February 2015

attained secondary school education. On the other hand, the attainment of secondary school education (be it SHS, Vocational, or Technical) constituted the highest proportion with respect to the households.

Table 2 explains the details of the educational characteristics of artisanal miners in Prestea.

Education is a requisite for community development. In view of this, parents and guardians send their wards to school to achieve higher education in order for the society to benefit in the long run. Education prepares one for life and to a large extent accumulates knowledge for later application in both local communities and international sphere. The people of Prestea view education as such and they share the same view with Thompson (1986). In view of this the inhabitants of Prestea strive to pursue some form of formal education regardless of any level.

Data collected from the field survey revealed that about 8% of the artisanal miners have not had any form of formal education, whereas 2.5% of the households have not had any formal education. The remaining 92% of the artisanal miners saw the essence of acquiring some form of formal education whereas 97.5% of the households also had some form of formal education regardless of the level.

However, the acquisition of higher education was one major characteristic of the household heads where majority (57%) had acquired as high as secondary school education and 17.5% of them had acquired tertiary education in the form of Training Colleges and University education. Meanwhile, the highest proportion of the small-scale miners which represents 72% of the interviewed had only acquired basic education (that is Primary and Junior High School education) and a few (20%) acquiring secondary school education. The high proportion of artisanal miners acquiring basic education as their highest level of education attainment

Majority (68%) of the youth whose ages range from 17 years to 34 years who are engaged in artisanal mining have only attained basic school. This buttress the point made by the traditional authority. The youth pay less attention to attaining higher education due to the fact that the venture in which they are engaged in pay them more money. On the other hand, the level of education of the households can be attributed to the place where the migration from to the community and the reason why they migrated to the community. This is discussed in the next subsection.

Origin of respondents: Migration is on the increase in Ghana from all parts of the country to places where greener pastures can be found. Prestea being one of the communities which is endowed with gold attracts lots of migrants into the community. Although the local people are highly engaged in the activity, migrants do

play their part as well. The field survey showed that 40% of the artisanal miners are migrants either from within the region (Western Region) or from other regions in Ghana. The migrants from the northern parts of Ghana amounted to 24% whereas other Akan migrants amounted to 16%. The migrants indicated that, it is due to employment that they migrated to the community. From the field survey, the indigenes of the community who are involved in the activity are the majority group. They constitute 60% of the total artisanal miners.

The artisanal miners outlined some reasons why they are into mining work. 43% of them outlined that, due to unemployment in the community in which they migrated from, the only venture which can support them is the artisanal mining sector. The remaining 57% gave other reasons why they are into artisanal mining though they attested to the fact that unemployment is one main reason why they are into mining. The other factors which were outlined include making a living, pressure from family and friends and the inability to obtain a job following a long search, among others.

Migration is also another characteristic which was identified with regards to the households' survey. About 72.5% of the respondents have migrated to the community. The majority of the migrants (62.5%) have migrated due to availability of employment opportunities. However, in the analysis of the highest level of education attained by the households, it was said that the majority of the households have attained higher level of education. To buttress this point, there is the need to compare the place of origin of the households to the occupations of the migrants.

57.5% of the migrants which form the majority of the migrants come from another district in another region whereas only 27.5% hail from the community and are mainly involved in either agriculture or commerce which does not require higher level of education attainment before entering into that occupation. Although 17.5% of the 57.5% of the migrants are engaged in either agriculture or commerce which is mostly trades that do not necessarily require higher education before engaging in. Households who are into civil or public service in the mining community form the highest proportion of the migrants. Interestingly, it is the migrants in the Prestea community who have attained higher education and that they occupy higher positions as civil servants. It can be inferred that the inhabitants of the community place little emphasis on attaining higher education, whereas migrants from other places in Ghana occupy higher civil/public positions due to their attainment of higher education.

Earnings by artisanal miners: The amount of money earned from the economic activity varies as indicated

by the respondents. Most respondents were reluctant to provide the financial information relating to their activity. But those who responded to this section revealed that, they could earn about GHC 200.00 to GHC 300.00 per week but varies though. They further indicated that, in a season of boom, they can earn as much as GHC 500.00 in a single trip. This indicates why lots of people both indigenes and migrants in the community prefer going into the venture other than going to other ventures such as trading. Although the artisanal miners earn much in a week, 60% of them do save either with the “susu” institutions (28%) or at the bank (32%) and the remaining 40% do not see the essence of saving with these institutions.

The respondents indicated that, they spend mainly on the basic needs. However, upon interviewing the traders in the community during the household survey, revealed that, though the artisanal miners do spend on basic needs such as food, rent, health, transportation, they do spend much on other things such as alcoholic beverages, mobile phones and other commodities which are tagged high priced commodities.

Artisanal mining being one of the dominant economic activities in Prestea community has a major role to play in the development of the community. As established earlier, the activity plays the role of providing employment to the unemployed, youth, migrants, among others in the community. In the case of those who do not engage directly in it, the activity indirectly provides employment to them in the sense that, they sell mining tools and equipment to the miners. Again, traders do benefit from the artisanal mining activity due to the fact that most artisanal miners do patronize their commodities at any price at most times. Therefore, the subsector has a role to play in the provision of employment either directly or indirectly to the people of Prestea thereby improving the economic growth of the community.

Methods of artisanal mining in Prestea: Artisanal mining in Prestea is practiced in four methods. These methods are practiced based on the mode in which the miners operate. These four methods of artisanal mining are the shallow alluvial small-scale mining, deep alluvial small-scale mining, the hard rock (lode) small-scale mining and the surface small-scale mining. The shallow and deep alluvial small-scale mining is mainly done in and along the banks and plains of the Ankobra River. Those who practice the hardrock (lode) method of small-scale mining undertake their operations beneath the ground where tunnels are built in order to reach the gold ore. With this category the miners bring their raw materials to the community for processing. Likewise, the surface small-scale miners perform their operations outside the built up area of the community. But this group of small-scale miners only excavates the surface of the soil.

Group of people engaged in artisanal mining in Prestea: Though the artisanal mining activity is tagged to be dangerous and as such requires persons with the requisite skills to undertake the activity, it was evident that, the dominant age group who are engaged in the activity are people ranging from eighteen to thirty five years (18 to 35 years) which forms eighty percent (80%) of the total artisanal miners interviewed, whereas people aged 36 to 61+ years constituted 12% and less than 18 years formed 8% of the total artisanal miners interviewed.

However, 72% of the artisanal miners have only achieved basic education whereas 20% had achieved secondary school education and a few 8% has never achieved formal education. None of the artisanal miners had achieved tertiary education. Forty percent of the artisanal miners were migrants either from other parts of Western Region or outside the region whereas thirty 36% migrated from the northern parts of Ghana.

Effects of artisanal mining in Prestea: The survey revealed both negative and positive effects on the socio-economic development of the community. The positive effects were evident in the economic aspect where the activity provides employment to the people of Prestea and its environs and boosting the activities of traders. Despite these positive economic benefits of artisanal mining, the activity has resulted in raising the cost of living in the community in the sense that, the prices of goods and services are relatively high. Similar view is shared by Appiah-Sefah *et al.* (2013) and Arthur and Sheffrin (2003) with respect to the economic basis in a given society.

Nevertheless, the activity exhibited lots of negative effects which include siltation of the community, destruction of the Ankobra River, depleting of forest resources, release of toxic gases into the atmosphere as the negative environmental effects of the activity (Antwi, 2010). This view is shared by Ashton *et al.* (2001) the extent of damage mining causes to the ecology is sometimes unparalleled. The Other effects which were identified with respect to the society and the people living in the community are discouraging of education, promoting drug and substance abuse and increased social vices among others. With respect to the health issues in the community, there were other negative effects with respect to the small-scale mining activities which include the prevalence of skin diseases, premature death and other respiratory related diseases.

What has been done about the situation: Several efforts have been made to minimize the numerous negative effects of the artisanal mining in the community. These efforts include the traditional authority organizing periodic sensitization exercises in educating the small-scale miners on the safe ways of undertaking their activities without bringing harm to

both the society and the environment. The town council has also made some efforts. It includes partnering the traditional authority in the provision of education to the artisanal miners and also organizing sensitization programmes concerning the dangers associated with artisanal mining. These efforts to help minimize the situation have yielded little or no results.

Effective collaboration and coordination among the authorities and the artisanal miners: The study has revealed that, though there have been some regulatory exercises which have been undertaken either by the Traditional Authority or the Town Council; artisanal mining continues to be on the increase and has brought negative effects on the community. It is therefore recommended that, there should be an effective collaboration and coordination among the two institutions.

By collaboration and coordination, the two institutions should work hand in hand. In doing so, effective strategies could be mapped out to help reduce the risks generated by the artisanal miners to themselves and the community as a whole with respect to the various effects which are mostly hindrances and negative implications to the development of the community despite the sector providing employment to the people.

As established earlier in this section one way the Traditional Authority have helped in reducing the negative effects of artisanal mining to the miners themselves and to the community as a whole is organizing safety precautions programme in the form of creating awareness to the artisanal miners. The Prestea Town Council has also helped in one way or the other in creating the awareness on the dangers involved in engaging oneself in small-scale mining either on the environment or on the individual involved or others who are not involved in the venture. The outcome of these efforts have proved to be wrong. Therefore, following the recommendation given, a strong bond can be created by the two authorities in the community by joining hands and helping minimize these effects. Proper education can therefore be given to the artisanal miners on the safety measures which can help them undertake their activities without creating lots of mess if the numbers of people or institutions participating in the sensitization programme increases. This can be achieved through the coming together of the two authorities in the community.

Routine assessment of artisanal mining operation in the community: Since artisanal mining continue to persist in the community, it is recommended that the joint forces of the Traditional Authority and the Prestea Town Council perform a physical assessment of the artisanal mining groups and individuals' mining activities and its associated effects which should be

effective quarterly every year. The outcome of this exercise should then be discussed by these three institutions. In doing so, preventive measures can be instituted and integrated in either the Prestea Community Plan or the Prestea Huni Valley District Medium Term Development Plan. This will help ensure and promote close supervision of the operations of the artisanal miners and the magnitude of damage caused by the artisanal mining activities for appropriate actions to be taken. At least, two members each from the three institutions (the Traditional Authority, Prestea Town Council and the Prestea Huni Valley District Assembly) should be involved in this exercise. This will ensure the effectiveness of the programme.

Strengthening and sensitization programme for artisanal miners: Consultation of the public is understood as a process of communicating to affected groups or individuals the consequences, benefits, duration, among others of an activity. However this forms part of sensitization process. As a result there is the need for authorities in the community to interact with these affected groups who are not miners to be able to address their concerns. This action will help those who are not miners to raise salient contributions towards minimizing the effects of the artisanal mining in the community. After undertaking this step or action, the artisanal miners might modify their ways of operating without disturbances to the other members of the community who are not artisanal miners. This should be undertaken by the Prestea Town Council in collaboration with Traditional Authority. This is because these institutions in the community have already undertaken sensitization programmes in the community and that undertaking this action will be feasible.

Enacting bye-laws to regulate artisanal mining activities within the community: Artisanal mining have brought negative impacts on the community. Despite the numerous sensitization programmes undertaken by the Traditional Authority and the Town Council, the activity continues to bring negative effects to the community. Interviews with the Prestea Town Council and the Traditional Authority revealed that, there is minimal attention as regards regulations that govern artisanal mining in the community. However, enacting a bye-law which will regulate the artisanal mining activity within the community and ensuring its operation will serve as some sort of measure to help reduce artisanal mining activities and its associated effects within the built up area of the community. The formation of these bye-laws to regulate artisanal mining should be undertaken by the Prestea Town Council, the Traditional Council and three mining companies in the community, head of each artisanal mining group and other opinion leaders in the community. The bye-law

which is recommended to be enacted should contain regulations which will guide where artisanal mining activities should be done in terms of obtaining the gold ore and processing it. There should be a regulation that bans the processing of gold within the community due to its health and safety implications.

CONCLUSION

Artisanal mining as seen by many researchers is mining by individuals, group of people or a corporation that mine for precious minerals, particularly gold, using minimum specifications on a small piece of land including rivers which is often done on illegal basis. This is evident in Prestea community where individuals and group of people mine for gold in which crude tools and methods are used in their operations. Though the sector has been seen by many as dirty, unprofitable and basically unsustainable, nevertheless, the sector provides lots of monetary benefits to the people of Prestea. Moreover, artisanal mining sector is seen in Prestea to be one of the major economic ventures in which people who are unemployed engage in to generate income which is used to cater for themselves and their families. These issues which have been outlined have to be addressed by the authorities in the community and the district, Prestea Huni Valley. Again, some recommendations have been made in order to help reduce the negative effects which artisanal mining has brought on the Prestea community in Ghana.

REFERENCES

- Adomaah-Basseah, M., 2011. Effects of small-scale gold mining on water resources: A case study of bogoso prestea mining area. PhD Thesis submitted to the Board of Postgraduate Studies, Kwame Nkrumah University of Science and Technology, Kumasi.
- Amankwah, R.K. and C. Anim-Sackey, 2004. Strategies for Sustainable Development Of The Small-Scale Gold and Diamond Mining Industry of Ghana. Mining Engineering Department, Queen's University, Kingston, Ont., Canada.
- Anon, 1989a. Small Scale Gold Mining Law PNDCL 218. Ghana Publishing Corporation, Ghana, pp: 1-5.
- Anon, 1989b. Mercury Law, PNDCL 217. Ghana Publishing Corporation, Ghana, pp: 1-2.
- Anon, 1989c. Precious Minerals Marketing Corporation Law, PNDCL 219. Ghana Publishing Corporation, Ghana, pp: 1-3.
- Antwi, F., 2010. An assessment of the impacts of Newmont Gold Ghana Limited (NGGL) on the socio-economic development after six years of operation in the Birim North District. PhD Thesis Submitted to the Department of Geography and Rural Development Kwame Nkrumah University of Science and Technology in Partial Fulfilment for the Degree of Master of Arts.
- Appiah-Sefah, G., J. Huang, K. Boateng and P.N. Nkrumah, 2013. All that glitters is not gold-environmental effects of small scale mining in Ghana. *Int. J. Scient. Eng. Res.*, 4(7).
- Arthur, S. and S.M. Sheffrin, 2003. *Economics: Principles in Action*. Upper Saddle River, Pearson Prantice Hall, New Jersey, pp: 552.
- Ashton, P.J., D. Love, H. Mahachi and P.H.G.M. Dirks, 2001. An overview of the impact of mining and mineral processing operations on water resources and water quality in the Zambezi, Limpopo and Olifants Catchments in Southern Africa. Contract Report to the Mining, Minerals and Sustainable Development (Southern Africa) Project, by CSIR-Environmentek, Pretoria, South Africa and Geology Department, University of Zimbabwe, Harare, Zimbabwe.
- Aryee, B.N., B.K. Ntibery and E. Atorkui, 2002. Trends in the small-scale mining of precious minerals in Ghana: A perspective on its environmental impact. *J. Clean. Prod.*, 11: 131-140.
- Besseah, M.A., 2011. Effects of small scale gold mining on water resources: A case study of Bogoso/ Prestea mining area. PhD Thesis Submitted to the Board of Postgraduate Studies, Kwame Nkrumah University of Science and Technology, Kumasi, in Partial Fulfilment of the Requirements for the Award of the Degree of Master of Science in Environmental Science.
- Cifuentes, E. and S. Rodriguez, 2005. Urban sprawl water insecurity and enteric diseases in children from Mexico city. *Eco Health*, 2(1): 70-75.
- Crispin, G., 2003. Environmental management in small scale mining in PNG. *J. Cleaner Prod.*, 11: 175-183.
- Darby, S. and K. Lempa, 2006. Advancing the EITI in the mining sector: Implementation issues. Proceedings of the World Bank's Oil, Gas and Mining Policy and Operations Unit (COCPO).
- Ghana Statistical Service, 2005. 2000 Population and Housing Census: Special Report on Localities and Districts, Western Region.
- George Thomson, Alexander Brudge, Mariana Buultjens and Margaret Lee 1986. "Scotland and the 1981 Education Act", *British Journal of Special Education*, 13 (3), 115-116.
- Hayford, E.K., A. Amin, E.K. Osaie and J. Kutu, 2009. Impact of gold mining on soil and some staple foods collected from selected mining communities in and around tarkwa-prestea area. *J. Home*, 14(1).
- Hentschel, T., F. Hruschka and M. Priester, 2002. Global report on artisanal and small-scale mining. Proceeding of the International Institute for Environmental and Development (IIED), London, pp: 4.
- Hilson, G., 2001. A contextual review of the Ghanaian small scale mining industry. *Mining Miner. Sustain. Dev.*, 76: 2-30.

- Hilson, G., 2001. A Contextual Review of the Ghanaian Small-Scale Mining Industry. Imperial College Centre for Environmental Technology, London, UK.
- Hilson, G., 2002a. Small scale mining and its socio-economic impact in developing countries. *Nat. Resour. Forum*, 26(1): 3-13.
- Hilson, G., 2002b. Harvesting mineral riches 1000 years of gold mining in Ghana. *Resour. Policy*, 28: 13-26. *Ibid* *Ibid*, 239-245.
- International Labour Organization (ILO), 1999. Social and labour issues in small scale mines. Report for the Tripartite Meeting on Social and Labour Issues in Small-scale Mines, Geneva, May 17-22.
- Interview, Nana Nteboa Prah IV, 2015. Prestea divisional chief. on phone, February 25.
- Interview, Osabarima Kofi Mensah, at his residence. February 12, 2015.
- Ragnar, A., 2005. Contamination of Water Resources in Tarkwa Mining Area of Ghana. Lund University, Sweden.
- Samuel, A. *et al.*, 2012. The impact and effect of illegal mining (galamsey) towards the socio-economic development of mining communities: A case study of kenyasi in the brong ahafo region. *Int. J. Modern Soc. Sci.*, 1(1): 38-55.
- Shoko, D.S.M. and D. Love, 2005. Gold Panning Legislation in Zimbabwe- What Potentials for Sustainable Management of River Resources. In: Mathew, K. and I. Nhapi (Eds.), *Water and Wastewater Man-agement for Development Countries*, IWA Water and Environmental Management Series. IWA Publishing, London, pp: 499-512.
- Unimax MacMillan Limited, 2001. Atlas of Ghana. Accra, Ghana.
- Veiga, M.M. and J.J. Hinton, 2002. Abandoned artisanal gold mines in the Brazilian Amazon: A legacy of mercury pollution. *Nat. Resour. Forum*, 26(1): 2. 2010 Population census