KWAME NKRUMAH UNIVERSITY OF SCIENCE AND TECHNOLOGY

COLLEGE OF ENGINEERING

DEPARTMENT OF MATERIALS ENGINEERING

ASSESSMENT OF THE IMPACT OF MINING ON THE LAND USE SYSTEMS AND LIVELIHOODS IN THE OBUASI MUNICIPALITY

BY

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OCTOBER, 2012

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A thesis submitted to the Department of Materials Engineering,

Kwame Nkrumah University of Science and Technology

in partial fulfilment of the requirements for the degree of

MASTER OF SCIENCE

in Environmental Resources Management

Department of Materials Engineering,

College of Engineering

OCTOBER, 2012

DECLARATION

I hereby declare that the work in this thesis submitted to the Department of Materials Engineering is the product of my own effort and has not been submitted for any degree elsewhere. The works of other authors used in this work have been duly acknowledgement by complete references.

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(HEAD OF DEPARTMENT) SIGNATURE DATE

DEDICATION

This thesis is dedicated to the entire Osei-Bagyina family; Mr. & Mrs. Osei-Bagyina, Bernard, Alberta, Juliana, Helen and Pius.

ABSTRACT

The mining sector is a very important segment of the extractive sector but has one of the most serious and disastrous environmental consequences conflicting with the livelihoods and survival of resident communities. Thus the study was conducted in the Obuasi Municipality to assess the impact of mining on the land use systems and livelihoods in the mining communities. Purposive and random sampling techniques were used and a total of 223 respondents were sampled from seven randomly sampled communities whose land use systems and livelihoods have been impacted by the mining activities. Seventy-eight farmers were sampled to assess the impact of mining on their land use systems whiles 145 respondents were sampled to determine the impact of mining on the livelihoods of the communities. Data collected was analysed with the Statistical Package for Social Scientist (SPSS) software. Descriptive statistics and multiple response tools were used for the data analysis and results presented in frequencies, percentages, means and ranges. Farming was the widely practised livelihood activity in the communities. Other livelihood activities identified were private security, trading, illegal mining, government work, AngloGold Ashanti (AGA) mining and others including labour, electricians, carpentry and driving. Farmers in the communities were into cocoa, oil palm, citrus and food crop production including cassava, cocoyam, plantain, yam and maize. These farming systems were either practised as mono cropping or mixed cropping systems, but the mixed cropping system was widely practised by farmers. Farmers in the communities faced several challenges from the mining activities in the communities. Rain-fed farming was widely practised by farmers with few farmers depending on water bodies mostly for the spraying of cocoa farms. Farmers who depended on these water bodies detected several negative effects on their crop

productivity including; yellowing and dying of crops before maturity, low yields, stunted growth and rotting of crops before maturity. Majority of farmers did not face any difficulty in accessing their farmlands and transporting farm produce from farmlands to communities although some farmers encountered these problems as a result of the mining activities in the communities. The negative externalities of mining have caused reduction in crop yields. Estimated average annual yields of cocoa reduced from 207.25kg/ha to 98.03kg/ha whiles average annual yields of citrus have reduced from 4707.77kg/ha to 3883.09kg/ha over an average period of 12years. Aside the negative externalities of mining, some community residents have benefited from employment opportunities provided by AGA and companies contracted by AGA although communities were not satisfied with the number of people employed. Most of the youth engaged in illegal mining activities because of unemployment and also because no alternative livelihood project have been implemented to provide them with the requisite skills. AGA has supported communities by providing them with infrastructure like pipe-borne taps, electricity, boreholes, schools and chief's palace and also contributes towards their maintenance, but communities had problems with the quality of water from the boreholes and pipes. Communities were not in conflict with AGA, although majority of respondents were anticipating the occurrence of future conflicts because of the destruction of community lands, lack of employment, AGA's refusal to fulfil the request of communities, prevention of illegal mining, inadequate compensation payment and the construction of smaller relocation buildings by AGA. Educational assistance for communities was very low as dependents of AGA workers were the only people privileged to have been provided with scholarship opportunities. It was recommended that farmers in the communities should form farming groups/ association to negotiate with AGA so as to protect the interest of its members. Also AGA should provide extension services for farmers to improve their current methods of farming to maximise profits. Furthermore in order for farmers to fully concentrate on their farming activities and adequately invest in their farms, AGA should inform communities about their operational plans so that farmers will not be at risk of having their farmlands destroyed by the mining activities. Because of the high unemployment rate AGA should implement alternative livelihood projects like livestock production, carpentry, bee keeping, soap making etc. to provide residents with other sources of income. Sources of water provided for the communities should be regularly sampled to determine the quality of water and AGA should link up well with other community members aside the leaders to be fully aware of their grievances to curb any future conflict occurrence.

ACKNOWLEDGEMENTS

My utmost gratitude to the Almighty God for granting me wisdom and strength to undertake this work successfully and for how far He has brought me in spite of all the challenges.

My special thanks to my supervisor Dr. Kwame Twum-Ampofo, Dept. of Agroforestry, Faculty of Renewable Natural Resources for helping me to come up with the research topic. I am also grateful for his supervision, advice and suggestions which greatly inspired me to complete this work successfully.

I would like to render my sincere thanks to Lecturers of Materials Engineering Department and Lecturers from other Departments for their constructive criticisms and suggestions during students' seminar sessions. And to my colleague students thanks for your moral support.

I gratefully acknowledge the contributions and suggestions of Mr. Elton Annan, the Community Relations Manager of AngloGold Ashanti and the Environmental Manager, Mr Peter Owusu Yeboah. They provided me with certain vital information I requested for in order to successfully undertake the work.

I wish to thank the chiefs and other opinion leaders of the communities I visited to undertake the study. I thank them for facilitating and permitting me to conduct my study in their communities and for the in-depth information they provided to support the work.

Finally, I wish to express my sincere thanks to my parents and siblings for their prayers and support.

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CHAPTER ONE

INTRODUCTION

1.1 Background

Gold dominates the mining sector and Ghana is Africa's second largest producer of gold after South Africa, the third largest producer of manganese and aluminium and a significant producer of bauxite and diamonds (Akabzaa and Darimani, 2001). The main minerals produced by large-scale companies are gold, diamond, bauxite and manganese, while industrial minerals such as kaolin, limestone and silica sand are mainly produced by small-scale operators. From the inception of Ghana's economic policy changes in 1983 to date, the mining sector has witnessed a considerable investment boom and increased production, particularly in the gold sector resulting in considerable growth in the number of new mines and exploration companies. Despite this boom, there is growing unease with regard to the real benefits accruing to the ordinary Ghanaian in the mining communities and to the country as a whole, in the light of the extremely generous fiscal and other incentives given to mining companies under the mining sector reforms (Akabzaa and Darimani, 2001).

All mining activities (on both large and small scales) in Ghana account for an area of 31,237 km^2, representing a share of about 13.1% of the country's total land area (238,608km^2). Reconnaissance licenses, which by definition and practice permit concurrent economic activities such as farming, cover 12,478 km^2 - about 40% of total land covered by mining activities. Mining accounts for 5% of the country's Gross Domestic Product (GDP) and minerals make up 37% of total exports, of which gold contributes over 90% (Boon and Ababio, 2009).

The mining sector is a significant contributor to formal and informal employment in the country (Akabzaa and Darimani, 2001). According to Yirenkyi (2008), 20,000 people are employed in large-scale mining whilst 500,000 are employed in the small-scale sector. Due to its labour intensity small-scale mining may generate significant employment avenues, especially in remote rural areas where alternative job opportunities are scarce and low paying. Apart from the direct employment contributions of small-scale mining, it also generates a substantial number of indirect jobs in other sectors of the economy (Obara and Jenkins, 2006). The Artisanal and Small Scale Mining (ASSM) sector is still not only largely unregulated but also profusely 'contaminated' with illegal artisanal or 'galamsey' miners. Their numerical strength and areas of operation remain largely unknown, although estimate places the figure at approximately 100,000 to 200,000 (Nyame and Grant, 2007).

No environmental problem associated with large-scale gold mining in Ghana has received more attention, both among Ghanaians and internationally, than deforestation. An astounding two million acres of forested land, including rainforest, are lost annually in Ghana to surface mining operations and this has adversely impacted rural communities by contributing to a decline in the productivity of agricultural lands. A substantial proportion of Ghana's poor live in rural areas where hundreds of thousands of people, largely unexposed to the wage economy, derive their livelihoods directly from small-scale agriculture and the natural resources provided by the country's forests (Armstrong, 2008). Agricultural farmlands taken for mining operations have resulted in the shortage of food and cash crop production, fuelwood production and environmental degradation. Peasant farmers whose lands are taken over for surface mining loose huge sums of money which in effect can be described as subsidies provided by poor farmers to rich multinational mining companies (Owusu-Koranteng, 2005).

Since mining projects are usually located in remote sites, mining companies have had to invest in considerable physical and social infrastructure such as roads, schools, hospitals, electricity and water supplies. Communities within mine locations have generally been beneficiaries of some of these facilities. At the same time, these communities have been victims of air and water pollution as well as other forms of environmental degradation resulting from mining operations. Mining also often requires a considerable degree of land alienation thus, while mining projects generally have weak links with the rest of the host national economy, they can have a decisive impact on the communities in which or near which the mines are located (Akabzaa and Darimani, 2001).

The mining industry in Ghana is a major contributor and player in national development, however, notwithstanding its positive contribution to national development; it is not without its own attendant problems, challenges and constraints. Thus, it is easy to understand the concerns, and hence, opposition from resource communities to the extraction of natural resources, particularly when one considers the fact that in the past there has been unequal distribution of benefits from resource exploitation (Aubynn, 2003).

1.2 Problems and Justification

The mining sector is a very important segment of the extractive sector but has one of the most serious and disastrous environmental consequences. Tropical ecosystems around the world are being wiped-out at a rate of 25 million acres per year. In many cases, resource exploitation by transnational corporations, including mining companies, is a primary cause of this devastation and occurs within the homelands of rural or indigenous peoples who scarcely identify with the nation, particularly in their daily life contestations. “During the last hundred years, mining has meant that probably 100 million people, most of them in developing countries, have been removed from the land where they lived and farmed". As the livelihoods and survival of these communities are strongly tied to the land, escalating development not only threatens the livelihoods of the people in resource frontiers, but also raises environmental and sustainability concerns. Therefore conflicts between mining companies and the local communities on whose lands the companies operate are not uncommon (Aubynn, 2003).

In Ghana, large tracts of agricultural lands are currently under mining concession and this could cover land areas from 50 km^2 to 4,000 km^2 and these concessions are agricultural lands that form the economic base of many mining communities (WACAM, 2008). Agricultural farmlands have been taken for mining operations, which have resulted in the shortage of food and cash crop production, fuelwood production and environmental degradation (Owusu-Koranteng, 2005). Many of the affected communities have lost their economic livelihood through displacement and areas that used to be important food production areas have become areas of net food deficit. Surface-based activities of mining mostly conflicts with farming, which is the main economic activity of residents in the remote communities in the country, therefore farmers are hard-hit in terms of direct dislocation, destruction of farmlands and perceived inadequate compensation. In the majority of the cases, farming communities that are displaced by mining operations are deprived of economic activities because they are resettled without access to land. Surface mining is gradually killing agriculture but the negative effects of mining on the agricultural sector are completely missing in the discussions of the rising cost of food prices (WACAM, 2008).

The much talked about alternative livelihood programmes of mining companies had not been able to restore the lost livelihood of affected people because of the ridiculous package of the programme (WACAM, 2008). According to Temeng and Abew (2009), mining companies are not willing to assume the traditional functions of government in providing general services to their areas of operation but these companies are increasingly pressured by growing international advocacy groups to minimise the negative impacts of mining activities on the environments and the local people.

It is therefore important to bring to light, the extent to which mining activities have co-existed and impacted the livelihoods and land use systems of mining communities in the Obuasi Municipality.

1.3 Objectives

The objectives of the research were to:

i. Identify the land use systems in the municipality.
ii. Assess the effects of the mining activities on the land use systems.
iii. Determine the effects of the mining activities on the livelihoods of the communities in the municipality.

Three areas considered under objective (ii) were;

- The effects of mining on the availability and quality of the source of water for farming.
- The effects of mining on the accessibility to farms and the transport of farm produce to the communities.
- The effects of mining on crop production and productivity.

Five areas considered under objective (iii) were;

- The effects of mining on employment and standard of living of employees of AGA, contract workers and illegal miners.
- Contribution of mining to infrastructural development and maintenance.
- Presence of conflicts and neighbourhood problems as a result of the mining activities.
- Contribution of mining to educational assistance.
- Impact of mining on sources of water for communities.

CHAPTER TWO

LITERATURE REVIEW

2.1 Mining in Ghana

Gold mining in Ghana has a very long history that dates back at least to the 15th century when the Europeans, beginning with the Portuguese and followed later by the Dutch and the English, were first drawn to the territory they called the "Gold Coast" by the trade in gold and spices (Amstrong, 2008). British and a few other foreign investors controlled the industry during the colonial period and Ghanaians were completely eliminated from the ownership structure of the mining industry. The industry was very vibrant during the pre- independence period and Ghana accounted for 35% of total world gold output between 1493 and 1600, but its share of world mineral output dwindled over subsequent years. The post-independence period was marked by state ownership of mineral resources. The period up to 1986 was generally characterised by stagnation of the industry, except for a few spikes recorded immediately after independence and in the early 1970's (Akabzaa and Darimani, 2001). As part of the country's Economic Recovery Programme (ERP) launched in 1983, the mining sector underwent significant reforms beginning in 1986. Since 1983, Ghana has been undergoing World Bank/International Monetary Fund sponsored Structural Adjustment Programme (SAP). This has meant a shift from an interventionist stance, which in the past, allowed the state to micro-manage the economy, towards a neo-liberal position which allows the market to allocate resources and the private sector a dominant role in the management of the economy (Aubynn, 2003).

Modern mechanized mining of precious metals from both alluvial and hard-rock dates back from about 1880, when this type of mining began in the Tarkwa area. In

1898, modern mining was extended to Obuasi in the Ashanti Region, where the gold deposits were found to be even richer than the Tarkwa deposits (Aubynn, 2003). AngloGold Ashanti's Obuasi Mine, which began production in the Adansi West District of the Ashanti Region in 1890, is by far the oldest mine in the country (Amstrong, 2008).

2.1.1 Large Scale Mining (LSM) and Artisanal and Small Scale Mining (ASSM)

Large scale mining is usually undertaken by big companies using many employees and a huge labour force. The company mines at large sites and continues the operations until the mineral or metal is completely excavated. Large scale mining also involves using huge bulldozers and excavators to extract the metals and minerals from the soil (Brayan, 2010).

According to Hentschel *et al*., (2003), artisanal and small-scale mining refers to mining by individuals, groups, families or cooperatives with minimal or no mechanization, often in the informal (illegal) sector of the market. For the purposes of classification, small scale miners are artisanal miners who are licensed to operate on a small piece of land and who are required to market their produce through the Precious Minerals Marketing Company (PMMC) or designated agents affiliated to PMMC and illegal miners/"galamseys" on the other hand, practice their trade without any regularisation or licence from the regulatory agencies (Nyame and Grant, 2007).

The two types of small scale mining are land dredging and river dredging (Brayan, 2010). ASSM operations can be subdivided in the same way, as conventional mining, according to type of deposit: underground mining; open pit mining and placer mining. Some small mining operations may have a semi-industrial or fully industrial character and the degree of mechanization, internal organization and compliance with international industrial standards is advanced. These operations are most frequently financed and managed by partners from industrialized countries (Hentschel *et al*., 2003).

In many parts of the world, artisanal or small-scale mining activities are at least as important as large-scale mining activities, particularly in terms of the numbers of people employed. Miners are generally unskilled and earn little. The most common equipment used are basic hand tools such as picks, axes, sluice boxes and shovels, although occasionally Honda water pumps, explosives and washing plants are seen within regions (Hilson, 2001). Small-scale mining can generate significant local purchasing power and lead to more demand for locally produced goods and services i.e. food, tools, equipment, housing, infrastructure (Hentschel *et al*., 2003). Artisanal and small-scale mining is the case in the majority of developing countries. The rapid growth in Ghana's artisanal and small-scale gold mining sector can be attributed to the acute lack of jobs and accompanying poverty nationwide (Hilson and Potter, 2005). The ASSM sector is the most difficult to regulate due, among others, to the nomadic and often seasonal nature of their activities (Nyame and Grant, 2007).

2.2 Mining Community Lands

The Government of Ghana, like most governments of mineralized economies, has pre-emptive rights over all minerals in its territorial lands, irrespective of administrative region. The minister has the right of pre-emption of all minerals raised, won or obtained in Ghana and from any area covered by territorial waters, the exclusive economic zone or the continental shelf and products derived from the refining or treatment of these minerals (Minerals and Mining Act, 2006).

According to the Provisional National Defence Council (PNDC) L153, Section 70 (3), communities only have surface rights to the land. Application for an exploration or mining licence is considered by a committee of the central government agencies, represented by the Minister of Lands, Forestry and Mines, the Minerals Commission, the Mines Department, the Environmental Protection Agency, and the Lands and Forestry Commission. Communities are not directly involved in the round table discussion for leasing community land. As a result, communities are often not informed of the proposals or intentions of land acquisitions, belatedly and sketchily informed of the proposals through public hearings, or completely left out of the initial negotiations. Thus the chiefs and residents in mining communities are not familiar with procedures related to land acquisitions for mining and once the mining company makes economic finds, negotiation for mining rights rests almost exclusively with the company and the central government agencies (Aubynn, 2003).

2.3 Land Use Systems and their Characteristics

2.3.1 The Concept of Farming Systems

A farming system is a population of individual farm systems that have broadly similar resource bases, enterprise patterns, household livelihoods and constraints, and for which similar development strategies and interventions would be appropriate (Dixon *et al*., 2001). The term also refers to a particular arrangement of farming enterprises that are managed in response to physical, biological and socio-economic environment and in accordance with farmer's goals, preferences and resources. "Farming System is a complex inter-related matrix of soil, plants, animals, implements, power, labour, capital and other inputs controlled in parts by farming families and influenced to varying degrees by political, economic, institutional and social forces that operate at many levels" (Behera and Sharma, 2007).

Farmers typically view their farms, whether small subsistence units or large corporations, as systems in their own right. Each individual farm has its own specific characteristics arising from variations in resource endowments and family circumstances (Dixon *et al*., 2001). A farm is characterized by goals and decisions, their boundaries, their activities and their relations, the internal and external relations as well as their structure which is function of internal and external relations (Izamuhaye, 2008). Diversity is the norm in African farming systems and even at the level of the individual farm unit, farmers typically cultivate ten or more crops in diverse mixtures that vary across soil type, topographical position and distance from the household compound. Farming systems in Sub-Saharan Africa (SSA) comprise many root crops, especially cassava but cereals are less important. Depending on the natural resource base and management systems, intensification can either sustain and improve productivity over time, or degrade the natural resource base and therefore lower production potential over time (Spencer *et al*., 2004).

The biophysical, socio-economic and human elements of a farm are interdependent, and thus farms can be analysed as systems from various points of view (Dixon *et al*., 2001). The farming systems can be described and understood as by its structure and functioning. The structure in its wider sense includes among others, the land use pattern, production relations, land tenures, size of holding and their distribution, irrigation, marketing including transport and storage, credit institutions and financial markets and research and education. Thus, the "farming system" is the result of a complex interaction among a number of interdependent components. To achieve it, the individual farmer allocates certain quantities and qualities of four factors of production: land, labour, capital and management to processes like crop, livestock and off farm enterprises in a manner, which within the knowledge he possess will maximize the attainment of goal he is striving for (Behera and Sharma, 2007). The functioning of any individual farm system is strongly influenced by the external rural environment, including policies and institutions, markets and information linkages. Not only are farms closely linked to the off-farm economy through commodity and labour markets, but the rural and urban economies are also strongly interdependent (Dixon *et al*., 2001).

2.3.2 Categorisation of Farming Systems

The delineation of the major farming systems provides a useful framework within which appropriate agricultural development strategies and interventions can be determined. The decision to adopt very broad farming systems inevitably results in a considerable degree of heterogeneity within any single system (Dixon *et al*., 2001). The classification of the farming systems of developing regions can be based on the following criteria proposed by Dixon *et al*., (2001) and Izamuhaye (2008):

- Available natural resource base, including water, land, grazing areas and forest; climate, of which altitude is one important determinant; landscape, including slope; farm size, tenure and organization; and
- Dominant pattern of farm activities and household livelihoods, including field crops, livestock, trees, aquaculture, hunting and gathering, processing and off-farm activities; and taking into account the main technologies used, which determine the intensity of production and integration of crops, livestock and other activities.

Some other criteria related to cultivation include; type of rotation (annual, perennial crops, etc), intensity of rotation, water supply, cropping pattern and animal activities, implements used for cultivation and degree of cultivation. Those criteria and broad grouping of farming systems are applied and names given are notably water source availability (irrigated, rain-fed, moist, dry); climate (tropical, temperate, cold); landscape(lowland, upland); farm size (large scale, medium scale, small scale); production intensity (extensive, intensive, etc.), cropping patterns (mixed, specialization, etc), etc (Izamuhaye, 2008).

2.3.2.1 Tree Crop Based System

'Tree crops' are woody perennials, which periodically produce a harvestable product that is of nutritional, monetary/commercial, environmental and/or accommodational value (Topper and Caligari, 1999). This farming system runs from Côte d'Ivoire to Ghana and from Nigeria and Cameroon to Gabon, with smaller pockets in Congo and Angola, largely in the humid zone. The system occupies 73 million hectares (three percent) of the regions land area, but accounts for 10 million hectares (6 percent) of total cultivated area and supports an agricultural population of nearly 25 million (7 percent of the regional total). The backbone of the system is the production of perennial crops which are important components of smallholder farming systems across the humid tropics of West and Central Africa. Cocoa, coffee, cashew and palm oil systems have provided sustainable and equitable pathways for broad-based rural development (Gockowski, 1999).

Tree crop farming, formerly reserved for large private or public investors, is today the major source of living for millions in many African countries. Most farmers operate in smallholdings, which are limited in size (less than 3 hectares) and rely on family labour, and are quite flexible when faced with managerial constraints. This explains why smallholders dominate the cocoa, coffee, and natural rubber sectors (Facheux *et al*., 2007).

Producers of tree crops in Africa vary greatly in terms of their intensity of production and their degree of diversification. The three types of farming systems with tree crops range from a subsistence household with no marketed surplus to a fully specialized household that grows only one cash crop and relies on the market for its food purchases. The majority of smallholder producers of tree crops in West and Central Africa, however, belong to the “mixed” farming group and are not solely dependent on tree crops for their rural livelihood. Land availability is also a factor in the intensification process. Farmers in areas where population pressures are low and land is abundant tend to have larger holdings that are managed more extensively. For the typical “mixed” tree crop producer in West Africa, the most relevant prices are those of the tree crop and the alternative commercial food crops. For more specialized and intensified producers, the most relevant prices are those of the tree crop and purchased inputs (Gockowski, 1999).

For the mixed farming group, food crops are inter-planted between tree crops and are grown mainly for subsistence. Roots and tubers (cassava, cocoyam and yam) are the main staples; tree crops and off-farm activities are the main sources of cash. Since neither tree crop nor food crop failure is common, price fluctuations for industrial crops constitute the main vulnerability. There are also commercial tree crop estates in these areas, providing services to smallholder tree crop farmers through nucleus estate and out grower schemes (Dixon *et al*., 2001).

An additional benefit in some areas is that the planting of trees crops can help in securing title deeds/ownership of land, which is critical for increased sustainable crop production in general. Smallholder systems are very variable even within a specific agro-ecological system, but they usually plant a number of tree species within their mixed or intercropping systems, along with a number of annual crops (Topper and Caligari, 1999). The earlier and diversified yields from understory crops can result in a higher net yield over time and also improve efficiency in land, labour and other farm resources (Wilkinson and Elevitch, 2000).

Finally tree crops have far greater importance to households and society because they are assets that farmers can often use as collateral for obtaining credit, provide a multitude of by-products such as fuelwood and medicines, and perform many environmental functions such as curbing soil erosion, sustaining biodiversity, and sequestering carbon. Tree crops also help to integrate local economies into wider markets by providing local, national and world-scale economic chains, incorporating numerous enterprises of all sizes and leading to a high multiplier effect (Facheux *et al*., 2007).

2.3.2.1.1 Cocoa Farming System

The majority of cocoa farmers in West Africa are smallholders, with 22 percent of cocoa produced on farms of less than two hectares, 65 percent on farms of between two and ten hectares and only 12 percent on plantations of more than ten hectares (Gockowski *et al*., 2004)**.** To affirm this, Baumann (2000), stated that cocoa, unlike tea, does not have large economies of scale; processing facilities can be designed to deal with different sizes of yield, therefore it is produced in many different sized holdings with smallholders predominating in West Africa. It is difficult to be clear about labour requirements, but farms of less than two hectares will be almost entirely family run and some of those in the lower end of the two to ten hectares will also be entirely family run (Gockowski *et al*., 2004)**.**

In Ghana, a national average of 212kg/ha of dried cocoa beans were reported in the early 1960s although higher yield of 3538kg/ha has been achieved on experimental plots (Amoah *et al*., 1995). The average national annual yield (350 kg/ha) in Ghana is very small compared to 800 kg/ha in Côte d'Ivoire, and 1700 kg/ha in Malaysia (Bosompem *et al*., 2006). Ghana to any noticeable degree: cocoa yields in the country remain low by comparative international standards: with an average of just under 400 kg/hectare on full bearing farms i.e. farms with tree stock of 10–15 years old (Vigneri, 2007). This has been attributed to low adoption and inappropriate application of innovations by cocoa farmers and a greater number of farmers are still using primitive technologies in this even though new technologies to improve yield and productivity are available (Bosompem *et al*., 2006).

According to Olaiya *et al*., (2006), highest cocoa yields are achieved between 15 and 25 years and that a profitable life span may be 50 years, but that from the 26th year yields decline gradually and production costs rise steadily. Trees grow to between 12 and 15 metres high, begin to yield fruit after three years and are fully productive at five. They continue to produce for at least another 20 years, although lack of inputs, in particular weeding, can considerably reduce yields (Gockowski *et al*., 2004)**.** Plot could only be declared unproductive if the yield has decline to about the quarter of what is obtainable at the peak period or if the average yield per tree per year in a hectare is less than twenty pods (Olaiya *et al*., 2006). About 25% of current cocoa-tree stocks are over 30 years old and over 60% of cocoa farmers are currently over 50 years old, and unwilling to take extra risk in investing in yield improvement strategies due to perceived high cost of input relative to producer price. Hence, cocoa cultivation is a low input venture undertaken on small farms using rudimentary technology with very little purchased input (Anim-Kwapong and Frimpong, 2005).

Cocoa is very suitable for adoption as part of a mixed cropping system with food crops, especially those that provide shade to the young plant such as banana and plantains, and so can be adopted with minimal disruption to traditional systems (Gockowski *et al*., 2004). Cocoa farmers do not have well established farming system combining food crops in particular with cocoa cultivation. The reason being that the shade that is provided for cocoa at the early stage does not allow food crops under it to do well. Also, cocoa farmers believe that they derive more income from cocoa production than food crop production; hence they devote most of their resources such as land, time and money toward cocoa production at the detriment of food crop production. The resultant effect of these is the shortages in food production in cocoa producing areas (Oluyole *et al*., 2009).

Cocoa plays a very important economic role for small farmers. As a cash crop it can provide necessary income for the purchasing of food and is especially important in areas where food security has been a problem. Farmers appear to be planting cocoa for a variety of reasons since one important reason is that neighbours are seen adopting the crop. Other reasons for planting include securing property rights, future income, high price, low labour, quick maturation, and yields throughout the year (Franzen and Mulder, 2007).

2.3.2.1.2 Oil Palm Farming System

Elaeis guineensis is an important oil producing crop throughout the world. For oil palm production, the ideal climate includes over 2,000 mm of evenly distributed rainfall per year, and with no marked dry seasons (Bergert, 2000). Water supply for oil palm is without doubt the most important production factor (Raemaekers, 2001). In Ghana, there were vast groves of oil palm but today, population pressure and intensification of agriculture has diminished the size and number of these groves and oil palms now more frequently occur integrated into farm lands (Bergert, 2000). The yield is defined by number of bunches and total weight of bunches per hectare (Amoah *et al*., 1995). Average yields from industrial plantations range from 12 to 18 tonnes of bunches/ha/yr for plant material with a yield potential of 18 to 20 tonnes (Raemaekers, 2001).

Plantation farming is a new phenomenon to West African culture and in most of Africa, the farm culture is basically subsistence and small-scale oil palm farm may cover 7.5 hectares (Ekine and Onu, 2008). Oil palm plantations have become one of the fastest growing mono cropping plantations in the tropics not only of Africa, but also in Asia-Pacific, and Latin America and the Caribbean **(**Tauli-Corpuz and Tamang, 2007). The great bulk of plantation oil palm is grown in monoculture, and maximum productivity is ensured by use of high-yielding materials, assisted pollination, and heavy fertilizer programmes (Watson, 1982). Plantations of selected oil palm begin producing fruit in their fourth year and their productivity increases steadily from then on to reach a ceiling at around the age of 8 or 9 years. After a stable period of 10-15 years the amount collected gradually declines, due to the difficulties of harvesting fruit from tall trees (Raemaekers, 2001).

In Africa oil palm has been a subsistence crop for generations. As such it tends to be an agroforestry crop that is interplanted with other cash and subsistence crops and in most cases, this type of production does not have a large impact on biodiversity (Stockbridge, 2006)**.** It has been shown that on good soils, intercropping of oil palm with food crops is quite possible and may even be advantageous. During the establishment of these tree crops farmers traditionally intercrop with food crops such as plantain, maize, cassava, cocoyam, pepper and many other annual crops, as a cultural practise for income to offset part of initial tree crop development outlay or as a source of food sustenance to the farmer (Amoah *et al*., 1995). In one major experiment, intercropping for as long as possible with a mixture of yams, maize, and cassava, followed by cocoyams as the palm shade developed, gave a net increase in yield of palm fruit as well as significant production of the food crops (Watson, 1982).

In Ghana, cocoa and oil palm could be seen growing in association on farmers farms and one major characteristic of a cocoa/oil palm intercropping is that these two crops have different labour calendars which do not interfere with each other. Thus in Ghana, whilst the peak yield and high labour requirements for oil palm occur between February and July, that for cocoa is between September to March. However with the restricted fibrous roots of the oil palm and the extensive superficial feeding roots of the cocoa there appears to be no adverse effect between oil palm and cocoa when they are interplanted. Underplanting oil palm with cocoa improves land usage, when planted in right component proportions and is capable of broadening the resource base of the farmer. The oil palm should however be planted at a wider spacing of about 10.5 metre triangular for optimal cocoa performance to be obtained than the usual spacing of 8.7 metre triangular (Amoah *et al*., 1995).

2.3.2.1.3 Citrus Farming System

Sweet orange (*Citrus sinensis*) is the most cultivated species of citrus in the world (Raemaekers, 2001). Citrus trees are grown throughout the world in tropical and subtropical areas, but they achieve the best quality under subtropical conditions (Izamuhaye, 2008). It is considered a product with an increasing export potential and gathering the orange for local market is done by either the farmers' family or hired labour according the farm size (Snouber, 2006). Apart from the concept of profitability over a full production cycle, the accumulated cash flow of a citrus farm is usually in deficit for the first ten years. A combination involving market gardening or another short cycle fruit crop (pawpaw, pineapple and banana) can be realised during the first four years of the plantation. This combination usually yields a positive cash flow and when the citrus plantation enters its fruit-bearing period, usually from the fourth year, cover legumes may be sown (Raemaekers, 2001).

Lumping all varieties of citrus together, an average yield of 30t/ha is expected from an orchard in full production (Raemaekers, 2001). No large-scale citrus plantations exist within the Ashanti Region but there are a number of small orchards seen here and there and most villages have a few trees around them (Adu, 1992). Worldwide production of citrus is estimated at 85 million tonnes and about 8.3 million of which comes from Africa (Raemaekers, 2001).

2.3.2.2 Food Crop Farming System

Food crop system are communities of plants which are managed to obtain food, profit, satisfaction or, most commonly, a combination of these goals (Norman *et al*., 1995). The major annual crops which are of great importance to most categories of farmers include the grain cereals – maize, sorghum, millet and rice; tubers – cassava, yam, sweet potatoes and Irish potatoes; others include beans, cowpea, soya bean and many varieties and species of vegetables. The world food revolves around these crops and the farmers make use of factors of production – land, labour and capital to ensure the feeding of the human race. The smallholder farmer produces crops for his family consumption and sells the surplus to the market and by so doing, the surpluses from these farmers when pulled together is very great that they contribute numerously in feeding majority of our people especially in the tropical and subtropical world (Ibeawuchi, 2007). Mixed and mono cropping systems are two types of cropping patterns mostly practised by farmers in food crop system.

Mixed Cropping System

A majority of the world's farmers, particularly those located in tropical regions, still depend on multispecies agricultural systems for their food and income, i.e. the cultivation of a variety of crops on a single piece of land (Malézieux *et al*., 2008). The most common tradition in African cropping systems is the spatial arrangement of crops on the field. The crops are established haphazardly in mixed culture, the objectives being to take advantage of local topographic features and micro-relief; disperse species at wide enough spacings so that they do not compete for nutrients and light; ensure that crop cover is adequate to control soil erosion and weeds; and ensure that each species requirements for sunlight are met (Agboola, 1982).

The practice of growing several crops on the same piece of land is an ancient strategy for crop production among farmers in the tropics. Traditionally, it is used by subsistence farmers primarily to increase the diversity of their products. Historically, however, it has been regarded as a primitive practice which would give way to sole cropping as a natural and inevitable consequence of agricultural development. The African husbandman has continued to use his traditional multiple cropping system, and where possible he has improved the system by adopting new crops and techniques, despite the efforts of expensive extension services to induce him to adopt mono cropping practices (Dixon *et al.*, 2001).

Dixon *et al*., (2001), stated that mixed cropping is the expression of African farmers desire to minimize risk and farmers are offered an insurance against total crop failure. The rationales for crop mixtures are that they may be relatively more profitable than sole cropping, the difference between the marginal value product of resources and the opportunity cost of the resources being insignificant; they are consistent with the goals of security and year-round subsistence needs; they may alleviate adverse conditions in the ecosystem; and they may maximize the space, water, and nutrients available (Agboola, 1982).

The disadvantages of traditional systems are that there is reduced yield of the component crops; there may be competition for light, nutrients, and water; there may be allelopathic effects due to excretion of toxic substances by one or more crops; the practice is not well suited to modern agriculture or mechanization and, thus, research on traditional systems has been inadequate; and suitable methods for investigation are difficult to define (Agboola, 1982).

Mono Cropping System

Mono cropping (monoculture or sole cropping) is the growing of a single crop on a piece of land within a growing season (Norman *et al*., 1995). Intensive agricultural systems are often based on optimising the productivity of monocultures. In those systems, crop diversity is reduced to one or very few species that are generally genetically homogeneous, the planting layout is uniform and symmetrical, and external inputs are often supplied in large quantities (Malézieux *et al*., 2008).

Despite many years of research and recommendations on sole cropping systems, smallholder farmers have unabatedly continued to grow their crops in mixtures. It is this disappointing response of most smallholder farmers unwilling to adopt improved technologies based on sole cropping systems that has lead to researchers and extensionists to the conclusion that progress can be made, if and only if new cropping systems are introduced based on a clear understanding and improvement of the traditional system (Hussaini *et al*., 2003).

2.3.2.2.1 Yam Farming System

Yams (tubers of several of the *Dioscorea* species) are a major component of rural people's livelihoods in Ghana. They are an important source of food and income for producers' households and an important food source for both local consumption and export (Kenyon and Fowler, 2000). Yams rank second to cassava as the most important tuber crop in Africa (Ibeawuchi, 2007). The best location for yam production is the sub-humid Guinea savannah, followed by the humid forest region and then the transitional forest savanna zone (Bamire and Amujoyegbe, 2005), and they grow best in deep, well-drained soils with a rainfall of 1000-3000mm in the absence of frost. Many researchers reported that the average yield of yam is at 10-12 tonnes per hectare but may range from less than 10 to more than 50 tonnes per hectare (Ibeawuchi, 2007).

Root and tuber production relies largely on smallholders utilizing slash and burn or other traditional practices (IITA, 2010). Yam is grown mainly by smallholders, covering approximately 10 percent of the country's cultivated land which is approximately one-third of the area planted to cassava. Together with cassava, they provide 31 percent of "national food security" and supply in excess of 50 percent of the calorie needs of the average Ghanaian (Kenyon and Fowler, 2000).

Yams are usually intercropped with maize, and vegetables such as cucurbits, pumpkins, peppers and okro. Monoculture is increasing in certain areas of West Africa and Caribbean. Yam/maize/cassava intercrop is productive and compatible mainly because maize is a short season crop while cassava and yams are long duration (7-12 months) crops. The two component crops of yam and cassava provide an example of the presence of competition gap within the period each of the component crops makes maximum demands on the environmental growth resources (soil-moisture, soil nutrients, light etc) and this results in higher total yields than the sole crops (Ibeawuchi, 2007).

2.3.2.2.2 Cassava Farming System

Cassava is one of the important staple crops in Africa. The average African yield of 7.7 mt/ha compares unfavourably with yields of 13.0mt/ha in Asia, 11.2mt/ha in Oceania and 12.4mt/ha in South America (Dahniya, 1994). In a survey dealing with cassava research by 37 institutions in 11 South and Central American countries, it was found that sole-cropped cassava is planted at an average density of 11,300 plants per hectare; intercropped cassava at a lower density of 8900 plants per hectare. When root production is the sole objective, densities around 10,000 plants per hectare are normally adequate for producing a large number of commercial- size roots, which are preferred for fresh consumption. In cases where root size is of no concern, higher planting densities can be used, resulting in a higher total production of small roots. For a combined objective of root and stake production, planting densities around 20,000 are adequate and if the sole objective is stake production, densities up to 40,000 plants per hectare are optimal. Whilst changes in planting density in the range of 2500 to 10,000 plants per hectare have usually produced a clear effect on cassava root yield, the crop appears to react much less to changes in planting pattern (Leihner, 2002).

Cassava is often grown under low-input/low output production systems, particularly when it is grown as a food crop. Planting material is easily obtained from the plant stems available from the farmers’ own or neighbouring fields. Although cassava is most common in the forest region and in the southern Guinea savannah, cassava based cropping systems are mainly found on poor sandy soils of the coastal belt where food crops other than cassava hardly give satisfactory yield except coconut or oil palm (Ibeawuchi, 2007). Cassava needs a sufficiently loose-textured soil, not only for initial fibrous root penetration, but also to allow for root thickening (Leihner, 2002).

Mixture yields of cassava in cassava/maize, or cassava/beans or cassava/groundnuts were reported to be similar to that of sole crop yield (Ibeawuchi, 2007). In these cropping systems, cassava is often found in mixed stands, together with a variety of other food or cash crops. Estimates indicate that at least one-third of the cassava grown worldwide is intercropped. When farmers adopt cassava intercropping as a production system, a relatively small plot suffices to provide the family with the basic dietary elements. Cassava is intercropped with both long- and short-season crops. Intercropping cassava with perennial species is not widespread and the vast majority of systems involve cassava as a long-season crop, combined with short-season annual food or cash crops. Maize, cowpea, common bean and groundnut are the commonest intercropping partners. Associations with grain legumes are particularly promising, not only because of their aforementioned nutritional advantages but also for their soil-improving potential (Leihner, 2002). Cassava can grow on a wide range of soils and can yield satisfactorily, even on poor acid soils where most other crops fail. The crop, therefore, plays a vital role in alleviating famine by providing sustained food supplies when other crops fail (Dahniya, 1994).

2.3.2.2.3 Maize Farming System

It is the third most important cereal crop of the world after wheat and rice (Ullah *et al*., 2007). Average maize yields per unit of land have fallen in Africa partly because maize cropping has expanded into drought-prone, semiarid areas, but a much greater negative influence on maize yield has been the loss of soil fertility, especially in wetter areas where yield potential is higher. Discounting the effects of erosion, the weathering of minerals and biological nitrogen fixation will enable, at most, 1,000 kg/ha of maize grain to be produced each year on a sustainable basis in the tropics. In hot lowland areas, such as in Ghana, this equilibrium is estimated to be even lower, at 600 to 800 kg/ha of maize grain annually (Kumwenda *et al*., 1996).

Due to high variability in climatic conditions, diverse soil types, population density and socio-economic factors, maize cropping systems are very diverse. They include intercropping systems for risk management and efficient use of land and labour resources and sole cropping systems. Sole cropping maize can be produced from high fertilizer inputs to sole cropped maize rotated with legumes (Ibeawuchi, 2007). Intercropping is an age-old practice of cultivation used by the farmers of tropical and sub-tropical countries (Adeniyan *et al*., 2007). Maize is mostly intercropped with vegetables and other crops in traditional agriculture mainly to satisfy dietary requirements (Ibeawuchi, 2007).

2.4 Impact of Mineral Resource Development

Mining activities in resource-dependent communities exert considerable impact on the environment, as well as on the lives of the people living within the vicinity. This impact may be positive as well as negative. For instance, mining companies provide employment for indigenous people; build infrastructure such as roads, clinics and schools; and, provide water and electricity when they move to the local communities (Aubynn, 2003).

In many cases, when mining activities move into mineral-rich communities, local inhabitants are forced to relinquish their farmlands and sometimes their settlements, to make way for the projects resulting in community disruption, including unemployment, cultural tension, disruption of community norms and values and environmental concerns due to environmental pollution and loss of biodiversity (Aubynn, 2003). Unfortunately, existing frameworks have not consistently ensured responsible behaviour in mining operations, and negative environmental and social impacts occur more frequently than they should (Miranda *et al*., 2005).

Resource dependency theory explains that communities dependent on non-renewable resources face the potential for decline when reserves are exhausted, widely influencing the "viability and vitality" of the socio-economic and cultural life of communities. While the resource curse theory, on the other hand, states that resource dependent economies/communities may not only fail to benefit from a favourable mineral endowment but may also perform poorly economically and developmentally, compared with those less endowed (Aubynn, 2003).

Recognizing these trends, some corporations have moved to distinguish themselves from competitors by subjecting their operations to independent scrutiny and establishing a verifiable chain of custody for products. Many have come to realize that compliance with the laws of the countries in which they operate may not be sufficient to protect the environment or vulnerable communities. Some corporations acknowledge the need for compliance with international codes, protocols, covenants, declarations, instruments, and customs that protect basic human rights, self-determination, cultural integrity, labour and social rights, and the natural environment and an example include the ISO 14001 standard (Miranda *et al*., 2005).

2.4.1 Economic Impacts

In terms of the economic benefits (if any) provided to the Ghanaian economy and population by the gold sector, an analysis of the contribution of extractive industries to national economic development typically employs the concept of retained value, which is "the share of the total value of production retained within the host country." In general, the greater the actual value accrued from the export and sale of extracted products that is returned to the economy, the more the economy is positively impacted by the sector (Armstrong, 2008).

The extensiveness of the fiscal incentives granted to the mining companies, including these very generous retention allowances, is undermining Ghana's national sovereignty and facilitating the corporate plunder of the nation's mineral wealth. Despite the fact that gold exports currently account for 40% of the nation's foreign exchange earnings, the gold sector only contributes 5% to GDP (Armstrong, 2008). Also the mining industry generates revenue for the internal economy through salaries, wages and other payments made to employees and contractors and also taxes on salaries of employees, and social security contributions from employees and their employers. Secondly through import duty and purchase tax on vehicles and corporate income taxes, royalties, concession rents, services, customs and harbour duties. Also the divestiture of state mining companies, sale of government shares and dividends to shareholders, equipment and consumables purchased locally and electricity and water charges generate internal revenue (Akabzaa and Darimani, 2001).

The mining sector is said to be a significant contributor to formal and informal employment in the country (Akabzaa and Darimani, 2001). According to Yirenkyi

(2008), 20,000 people are employed in large-scale mining whilst 500,000 are employed in the small-scale sector.

2.4.2 Social Impacts

Poverty, illiteracy and the low consciousness that mining communities have about their rights have provided grounds for the violation of the rights of communities by mining companies. The violations include loss of livelihood, displacement, forced evictions, Police/Military brutalities, and destruction of important cultural/spiritual heritage, forced evictions, shooting and killing of community people, through mineral extraction. Other violations include unlawful arrests and detention, violation of communities' economic, social, and cultural rights, violation of the right of communities to clean and healthy environment and demolition of communities without due process of law (Aubynn, 2003).

2.4.2.1 Violence in Mining Communities

Over the last two decades, communities on the fringes of large-scale mining projects have been subjected to the increasing use of intimidation, abuse, violence, and violations of human rights by mining company and state security agencies, including forceful evictions, arbitrary arrests, illegal detention, the demolition or burning of villages, beatings, shootings, dog attacks, rape, and murder (Armstrong, 2008).

A fact finding mission carried out by Ghana's Human Rights and Administrative Justice Committee in the Wassa West area confirmed these reports when it found "overwhelming evidence of human rights violations occasioned by the mining activities which were not sporadic but a well established pattern common to almost all mining communities". On July 13th, 2005, the Ghana military opened fire on a crowd of demonstrators in Prestea protesting against the negative impacts of the mining operations of Bogoso Gold Ltd. on their community and seven people were wounded, including a 13-year-old boy (Armstrong, 2008).

2.4.2.2 High Cost of Living

One of the known, negative effects of mining is the high cost of living within communities near mine locations. All the indices like food, accommodation, health, water, etc that make a decent life have a price tag beyond the reach of the average person. At the same time, the traditional sources of recreation and livelihood of the people are seriously impaired by mining activities, a situation that sparks off or aggravates other social problems. There are several factors responsible for the high cost of living in mining communities. First, there is the disparity in incomes in favour of mining company staffs. Secondly, the mining industry has withdrawn a significant percentage of the labour force from agriculture and other income-generating activities by taking farmland away and holding out the false promise of employment. The fall in food production in some mining communities with relatively high population and high unemployment, accounts for high food prices (Akabzaa and Darimani, 2001).

2.4.2.3 Alienation and Displacement of Mining Communities

Alienation is to be estranged from oneself, others or the product of one's labour and the concept of resource alienation is a process of exclusion and displacement of local people from the use of land-based resources (Aubynn, 2003). Displacement involves not only the physical eviction from a dwelling, but also the expropriation of productive lands and other assets to make possible an alternative use (Downing, 2002).

Investigations into displacement have found other potential risks that deeply threaten sustainability; these include joblessness, homelessness, marginalization, food insecurity, loss of common lands and resources, increased health risks, and social disarticulation. Affected peoples are those who stand to lose, as a consequence of the project, all or part of their physical and non-physical assets, including homes; communities; productive lands; resources such as forests, rangelands, fishing areas, or important cultural sites; commercial properties; tenancy; income-earning opportunities; and social and cultural networks and activities. It may also include "host communities" when a large population is displaced onto the land of a smaller existing (host) population. Of those affected, certain groups of indigenous people especially the elderly and women have been found to be more vulnerable to impoverishment (Downing, 2002).

Local communities in Ghana's mining district have lost or are in the process of losing their access to basic subsistence resources, in favour of national economic production. The argument is that the local people have yielded their main resources and their sources of livelihood (land) to mining companies for the production of gold, and in the process have suffered procedural and substantive alienation. Procedural alienation occurs when communities are excluded from the initial negotiation for acquiring community land for mining. Substantive alienation also involves forcible surrender of local resources for developmental purposes. Resource alienation in Ghana has substantively resulted in loss of community land, unemployment, and conflict with mining companies (Aubynn, 2003).

2.4.2.4 Increased Prostitution and Drug Usage

Many mining boom towns swell with job seekers and their families and nearby farmers displaced by the mine. They converge on towns and cities, increasing demand for social services and in many cases changing the character of a place. Increased alcoholism, prostitution, drug use and other crime can increase with the influx of job seekers. The influx of mining activities has brought both migrant and resident sex workers to mining communities. The increased incidence of HIV/AIDS in the Wassa West District, the highest in the Western Region, has been attributed to the flourishing sex trade. Harsh economic conditions have also led to growing drug usage in the area, particularly among the prostitutes and migrant illegal gold miners (Armstrong, 2008).

2.4.3 Environmental Impacts

Mining activities in Ghana have caused widespread ecological degradation and Ghana's Environmental Protection Agency (EPA) has, since its inception in 1994, lacked the necessary capacity in terms of both human and financial resources to carry out its job of ensuring compliance with the nation's environmental regulations (Armstrong, 2008).

2.4.3.1 Pollution and Depletion of Water Supply

Water pollution occurs when a body of water is adversely affected due to the addition of large amounts of materials to the water and water is considered polluted when it is unfit for its intended use (Owusu-Koranteng, 2008).

Traditionally, rural people establish their communities around rivers and streams for food production, river-based employment, recreation and cultural reasons in addition to the satisfaction of biological and household needs. Community people have good reasons to live along natural resources especially in a developing economy as ours where provision of potable water and income activities are an illusion even for many urban communities but water also constitutes the primary vehicle by which mining contamination can be transferred to the environment (Owusu-Koranteng, 2008).

The introduction of open cast gold mining in the 1980s had a lot of implications for fresh water protection. The Obuasi and Tarkwa areas of Ghana have undulating topography and it is believed that the development of extensive mining operations in ecologically sensitive area with undulating topography would certainly give rise to environmental problems. Industries including mining look at fresh water as free good which is exploited with lack of effective regulatory framework and had deforested headwaters because there was no incentive to conserve water. The proliferation of surface mining companies has resulted in stream pollution resulting from cyanide spillages, acid mine drainage, tailings leakages, mine waste disposals, and mine pits. These have tended to deprive communities of access to water, which is a basic need for human survival (Owusu-Koranteng, 2005).

2.4.3.1.1 Surface Water Quality Issues

One of the problems that can be associated with mining operations is the release of pollutants to surface waters. Many activities and sources associated with a mine site can contribute toxic and nontoxic materials to surface waters. Open pits, tailings ponds, ore and subore stockpiles, waste rock dumps, and heap and dump leach piles are all potentially significant sources of toxic pollutants. Impacts on surface waters include the build-up of sediments that may be contaminated with heavy metals or other toxics, short- and long-term reductions in pH levels (particularly for lakes and reservoirs), destruction or degradation of aquatic habitat, and contamination of drinking water supplies and other human health issues (U.S. EPA, 1997).

Impact of Heavy Metals on Surface Water

Mining activities exposes metals that have been relatively immobile in a tightly bound subsurface causing them to leach into surface and ground waters in large quantities when the mined rocks are exposed to air and water. Metals at very low dissolved levels and presence of such heavy metals above a certain threshold can be injurious to human health and the environment, particularly aquatic life. Since waste rock dumps are not lined, containment of contaminants from waste rock is frequently an issue (Miranda *et al*., 2005).

Of major concern in terms of both the environment and public health are the cases of cyanide mismanagement by several gold mining firms which have led to the cyanide contamination of freshwater resources and soils, adversely impacting local fish and wildlife populations and the health and livelihoods of rural farming and indigenous communities. The cyanide-laced water and sediment is stored in massive plastic-lined tailings ponds that are supposed to hold the cyanide waste, but the ponds inevitably leak or the dams restraining them fail, allowing cyanide to pollute the water table or nearby rivers and streams (Armstrong, 2008). Mercury also constitutes a major pollutant of surface and ground waters in and around mining communities (Akabzaa and Darimani, 2001).

The generation of Acid Mine Drainage (AMD) which primarily depends on the mineralogy of the rock material and the availability of water and oxygen and generated at both abandoned and active mine sites is of serious concern. AMD occurs at mine sites when metal sulphide minerals are oxidized which are common constituents in the host rock associated with metal mining activity. Mining and beneficiation operations greatly increase the rate of these same chemical reactions by removing sulphide rock material and exposing the material to air and water. Mined materials (waste rock or tailings) used for construction or other purposes (e.g., road beds, rock drains, fill material) or off a mine site can also develop acid drainage. Once acid drainage has occurred, controlling the releases is a difficult and costly problem, so prediction is becoming an important tool for regulators and operators (U.S. EPA, 1997). Hydro chemical analytical results of water bodies in Obuasi showed that streams in the study area are more polluted than groundwater with the groundwater iron and arsenic values exceeding the maximum permissible World Health Organization (WHO) guide values in some of the samples (Owusu-Koranteng, 2008).

Effects of Soil Erosion on Surface Water

Erosion can be a major concern at mining sites because of the large area of land disturbed by mining operations and the large quantities of earthen materials exposed at sites. Erosion may cause significant loadings of sediments (and any entrained chemical pollutants) to nearby water bodies, especially during severe storm events and high snow melt periods. The ultimate deposition of the sediment may occur in surface waters or it may be deposited within the flood plains of a stream valley (U.S. EPA, 1997).

Major sources of erosion/sediment loadings at mining sites can include open pit areas, heap and dump leaches, waste rock and overburden piles, tailings piles and dams, haul roads and access roads, ore stockpiles, vehicle and equipment maintenance areas, exploration areas, and reclamation areas. Minerals associated with deposited sediments may depress the pH of surface runoff thereby mobilizing heavy metals that can infiltrate into the surrounding subsoil or can be carried away to nearby surface waters. Contaminated sediments in surface waters may be a persistent source of toxics thus a chronic threat to aquatic organisms and/or human health.

Contaminated sediments may also lower the pH of soils to the extent that vegetation and suitable habitat are lost (U.S. EPA, 1997).

Dewatering Effects on Surface Water

Dewatering effects are key environmental concerns of surface mining. In addition to consuming large quantities of water in the heap-leach process, to clean and maintain equipment, and for those who live and work in the mines, the mass excavation of land by open-pit mines and the piling of earth along waterways alters the natural course of rivers and streams, ultimately reverse the direction of flow of ground water thereby depleting the ground water in some areas thereby resulting in dewatering. Since the mines need to be kept dry, most of the mining companies have active dewatering programs to deliberately divert major rivers and streams away from the area or to lower the water table. As a result a number of boreholes, hand-dug wells and streams in mining areas have either become unproductive or now provide less water (Akabzaa & Darimani, 2001).

2.4.3.1.2 Ground Water Quality and Quantity

Ground water impacts due to mining are not as widespread as surface water impacts because of the much slower velocity of ground water movement, the more limited extent of many affected aquifers, and the lack of available oxygen to continue the oxidation process. Nevertheless, the fact that ground water contamination is extremely difficult to remedy once it occurs makes it a serious concern (U.S. EPA, 1997).

Mining operations can affect ground water quality in several ways. The most obvious occurs in mining below the water table, either in underground workings or open pits and this provides a direct conduit to aquifers. Ground water quality is also affected when waters (natural or process waters or wastewaters) infiltrate through surface materials (including overlying wastes or other material) into ground water. Contamination can also occur when there is a hydraulic connection between surface and ground water. Any of these can cause elevated pollutant levels in ground water (U.S. EPA, 1997).

Further, disturbance in the ground water flow regime may affect the quantities of water available for other local uses and ground water may recharge surface water down gradient of the mine, through contributions to base flow in a stream channel or springs. The ability of pollutants to dissolve and migrate from materials or workings to ground water varies significantly depending on the constituent of concern, the nature of the material/waste, the design of the management, soil characteristics, and local hydrogeology (including depth, flows, and geochemistry of the underlying aquifers). Risks to human health and the environment from contaminated ground water usage vary with the types of and distance to local users. In addition, impacts on ground water can also indirectly affect surface water quality--through recharge and/or seepage (U.S. EPA, 1997).

2.4.3.2 Depletion of Vegetation and Soil

The socioeconomic externalities of surface mining (e.g., loss of livelihoods, lower incomes, declines in food production, and higher costs of living) already severely threaten household food security in rural areas and on top of these inequities, the accelerating rate of deforestation only further exacerbates the deterioration of natural resources in the gold belt that is leading to the rising incidence of hunger. Large-scale deforestation, soil fertility loss, and soil erosion have contributed to the very low level of agricultural productivity in general, and food agriculture in particular, "with current average yields about 40% of achievable yields". This has adversely impacted rural communities by contributing to a decline in the productivity of agricultural lands (Armstrong, 2008).

Arsenic (As) is widely distributed in the environment, originating either from arsenic in the soil parent material or from discharge of arsenic onto land as a result of human activities (Chaturvedi, 2006). The effect of arsenic pollution in Ghana is mainly seen in those gold mining towns where sulphide ore is treated. For example, arsenic pollution in and around Obuasi has resulted in wilting and discoloration of leaves of both tap-rooted and fibrous-rooted plants in the area, which has had a serious adverse effect on agricultural activities particularly the production of cocoa, oil palm, cassava, plantain, cowpea and rice (Gawu, 2009). Due to withering of vegetation, soil erosion also tends to be severe in these areas (Chaturvedi, 2006). Due to the high pH of cyanide discharge from treatment plants, vegetation does not flourish in areas where these cyanide-rich tailings are located as can be seen at Obuasi (Gawu, 2009). Biomass production and yields of a variety of crops are reduced significantly at elevated arsenic concentrations and also understanding how arsenic is taken up by plants and subsequently transformed in plant tissue is therefore essential for estimating the risks posed to human and wildlife populations by arsenic contaminated soils (Chaturvedi, 2006).

2.4.3.3 Air and Noise Pollution

Air pollution resulting from mining activities comes about by the generation of dust, noise, emissions of black smoke, vibration and mine gases especially during drilling, blasting, crushing and mineral beneficiation (Gawu, 2009). The activities that generate particulate matter also include site clearance and road building, loading and haulage, vehicular movement, ore and waste rock handling as well as heap leach crushing by companies doing heap leach processing. The sources of noise and vibration in mining communities include mobile equipment, air blasts and vibration from blasting and other machinery. The effect of high-pitched and other noises is known to include damage to the auditory system, cracks in buildings, stress and discomfort (Akabzaa and Darimani, 2001).

The principal gases released from mining activities in the country include arsenic, cyanide, sulphur dioxide, carbon monoxide and oxides of nitrogen. Most of the gold in Ghana is usually finely disseminated and associated with pyrites, arsenopyrites and other sulphur minerals. Sulphide ores are usually roasted in which case arsenous oxide, sulphur dioxide and carbon dioxide are released. Furthermore, large amount of silica-rich dust is usually generated during mining activities which when inhaled can cause severe colds, silicosis and can also cause plant defoliation (Gawu, 2009). The effects of dusts produced by mining activities on building materials are often limited to the visible soiling caused by the accumulation of particles on surfaces. Dust emission rates vary and depend upon: the local geology; level of activity on site; extent of vegetation cover; size distribution, moisture content and method of storage of bulk material; crust formation on the surface of stored material; rainfall, humidity, ambient temperature and wind conditions; and methods of operation and materials handling (DERM, 1995).

2.5 Land Use Disputes in Ghana's Mining Communities

Environmental conflicts are manifold throughout the world. These conflicts often emerge as local resistances to projects that restrict local communities' access to natural resources, that degrade or carry the risk of degrading the resource base on which they depend and/or pose risks for human health and community life. In fact, the diversity in the ways such conflicts unfold is most profoundly reflected in the different languages these actors employ while arguing for or against alternative resource uses, such as economic benefits, local development, territorial rights, environmental and social justice, livelihood, and ecological integrity (Avci *et al*., 2009).

2.5.1 Land Use Disputes between Large Mining Companies and Local Communities in Ghana

Many surface mining activities take place on indigenous lands that provide land-based livelihoods to many rural people. Mining takes place in areas of high illiteracy and poverty and mining communities with weak capacity, face the challenge of negotiating on highly technical issues with mining companies that can afford to employ the services of competent experts (Owusu-Koranteng, 2005).

The languages used in environmental conflicts are manifold due to the involvement of a broad range of actors, the multiplicity of issues raised, and the unique constellation of economic, political and social forces in each particular case. On the resistance side, an important reason for the opposition to activities that deprive communities of access to natural resources and pollute the environment is local people's dependence on the environment 'as a source and requirement for livelihood', where livelihood is understood as a source of identity, and environment seen as constitutive of the community and its way of life (Avci *et al*., 2009).

The subordination of surface rights of mining communities to the mineral rights of mining companies provides a basis for conflicts especially when marginalised communities do not have avenues to seek redress for the many grievances that confront them in the event of mining because of poverty and ignorance. Surface mining displaces many communities with grave consequences on livelihoods of communities (Owusu-Koranteng, 2005). Of special importance here is the situation of indigenous communities who claim traditional rights to land and resources and maintain distinctive cultures, and of the rural women who interact closely with the environment in their daily lives for their provisioning role in the household. These groups are hit harder by pollution and restricted access to resources, so that they are usually at the frontline of environmental conflicts in defence of their livelihoods (Avci *et al.*, 2009).

Resettlement schemes of mining companies have led to the breakup of families through the reduction of rooms and construction of building types that do not preserve cohesion of our extended family system. In most cases, resettlement packages have been imposed on mining communities and the state security apparatus had been used in forced resettlements and evictions. Compensation regimes are low and do not restore the livelihood of affected people (Owusu-Koranteng, 2005). As the livelihoods and survival of these communities are strongly tied to the land, escalating development not only threatens the livelihoods of the people in resource frontiers, but also raises environmental and sustainability concerns. During the last hundred years, mining has meant that probably 100 million people, most of them in developing countries, have been removed from the land where they lived and farmed. In light of this, conflicts between mining companies and the local communities on whose lands the companies operate are not uncommon (Aubynn, 2003).

Hence, differences in risk perceptions and trust in institutions that provide knowledge on, implement or manage resource extraction projects may potentially affect how people conceive the resource extraction activity in question, as well as which languages they use to support or oppose it (Avci *et al.*, 2009). Thus, it is easy to understand the concerns, and hence, opposition from resource communities to the extraction of natural resources, particularly when one considers the fact that in the past there has been unequal distribution of benefits from resource exploitation (Aubynn, 2003).

2.6 Corporate Social Responsibility (CSR)

The World Business Council for Sustainable Development (WBCSD) defined CSR as the "continuous commitment by business to behave ethically and contribute to economic development while improving the quality of life of the workforce and their families as well as of the local community and society at large"(Boon and Ababio, 2009). In response to heightened global awareness of sustainability, environmental and ethical issues, CSR has become a priority concern in the mining industry (Obara and Jenkins, 2006). CSR is a means by which companies can frame their attitudes and strategies towards, and relationships with, stakeholders, be they investors, employees or, as is salient here, communities, within a popular and acceptable concept (Jenkins and Obara, 2006). In the mining industry, progress within the three dimensions of sustainable development (economic, environmental and social) could be achieved through economic development i.e. investment of generated revenues to ensure the future development and long-term livelihood of the communities; environmental protection – minimising the environmental impact of natural resource exploitation and land rehabilitated to allow successive use; and social cohesion – reducing the social and cultural disruption to communities, maintenance of stakeholder dialogue and transparency of operation (Jenkins and Obara, 2006).The last twenty years have seen a radical change in the private sector's relationship both with the state and civil society. Companies are increasingly recognizing that improving their own impacts and addressing wider social and environmental challenges of the communities they operate in will be crucial in securing their long-term success (Boon and Ababio, 2009).

One of the more serious CSR policy challenges faced by governments and companies in mineral-rich developing countries is the equitable resolution of disputes between small- scale and large-scale mining; one country where this issue has become noticeably intense is Ghana. Several small-scale mining communities mainly individuals carrying out illegal activities have surfaced, operating alongside the country's large-scale mining companies (Obara and Jenkins, 2006).

2.6.1 Corporate Social Responsibility in Mining Communities

The discovery, extraction and processing of mineral resources is widely regarded as one of the most environmentally and socially disruptive activities undertaken by business. Indeed many of the environmental disasters or human rights incidents that have contributed to the growing public concern about the actions of companies over the last 40 years have taken place in the extractive industries (mining sector). The global mining sector has consequently begun using CSR as a basis for addressing the needs of its stakeholders (Obara and Jenkins, 2006). For the mining industry, CSR is about balancing the diverse demands of communities, and the imperative to protect the environment, with the ever-present need to make a profit. Corporate Social Responsibility requires companies to respond, not only to their shareholders but also to other stakeholders, including employees, customers, affected communities and the general public, on issues such as human rights, employee welfare and climate change and is a helpful conceptual framework for exploring the corporate attitude of companies towards stakeholders (Obara and Jenkins, 2006).

2.6.2 Community Engagement

With longstanding reputations for being environmentally destructive and socially disruptive, multinational mining companies have incorporated such terms as 'sustainable development' and 'environmental management' into their corporate dialogues in an attempt to show that they are tackling problems with improved strategy and practice (Obara and Jenkins, 2006).

A key stakeholder for all mining companies, and therefore a strong focus for their CSR initiatives, is 'the community'. Mining has a huge impact on local communities; positive effects include the creation of new communities and wealth, income from export revenues and royalties, technology transfer, skilled employment and training for local populations and improvements in infrastructure such as roads, schools and health clinics. The numerous social and environmental issues associated with the mining industry include access to land issues at the exploration and mining stages, environmental pollution, damage to the health of affected communities and the increased mechanisation of the industry, which negatively impacts employment levels (Jenkins and Obara, 2006). Considerable effort has been made by the industry to highlight its commitment to both protecting the environment and addressing the needs of affected communities and this is evident in the gold mining sector where local communities play an important role in stakeholder relationships (Obara and Jenkins, 2006).

Many companies have attempted to negotiate with important stakeholders and formalise agreements with indigenous communities and central and regional governments to address areas of concern. Some mining companies are making attempts to face the social and environmental concerns and issues associated with the gold mining industry in order to improve resource efficiency, and are undertaking stakeholder liaison exercises to prevent future confrontations. In Ghana, resident large-scale gold mining companies assert that they are providing support for indigenous communities. Specific examples of CSR initiatives being carried out include the implementation of Local Economic Development (LED) projects, construction of community infrastructure, and local employment (Obara and Jenkins, 2006).

2.6.3 The Reality of CSR in the Mining Sector in Ghana

Corporate Social Responsibility programmes of mining companies tend to focus on community initiatives because the economic, social and environmental impacts of their operations are basically felt greatest at the local level. Most mining companies have concentrated their CSR interventions in the areas of education, health, and alternative livelihood income generating activities (Boon and Ababio, 2009).

The large scale mining companies, which are members of the Ghana Chamber of Mines (GCM), have set up Trust Funds to ensure adequate funding for their social investment activities. Goldfields Ghana established a foundation in 2002 and derives CSR funding from its production and profitability situation which is based on a yearly contribution of US$ 1.00 of every ounce produced plus 0.5 percent of pre-tax profits (over US$ 1 million a year for financing social investment projects) (Boon and Ababio, 2009).

Immediately a new mining operation starts up, local communities often view it as an opportunity to be exploited, to be provided with resources and infrastructure that will enhance their welfare. However, many of the social opportunities provided by CSR activities border on creating a culture of dependency. The environmental damage caused by mining may result in the loss of land for other economic/livelihood uses (example agriculture) which leads to greater dependency on the mine. Communities that are affected by mining operations, either by loss of land and livelihoods or the need to relocate are dependent on mining companies for payouts to remediate this damage which leads to the imposition of a handout dependency (Boon and Ababio, 2009).

2.7 Sustainable Livelihood (SL) Approaches

A livelihood comprises the capabilities, assets (including both material and social resources) and activities required for a means of living (Haider, 2009). A livelihood is sustainable when it can cope with and recover from stress and shocks, maintain or enhance its capabilities and assets, and provide sustainable livelihood opportunities for the next generation; and which contributes net benefits to other livelihoods at the local and global levels and in the short and long term (Krantz, 2001). Livelihoods approaches are a way of thinking about the objectives, scope and priorities for development. They place people and their priorities at the centre of development. They focus poverty reduction interventions on empowering the poor to build on their own opportunities, supporting their access to assets, and developing an enabling policy and institutional environment (Twigg, 2001).

2.7.1 Alternative Livelihood Projects (ALPs) in Mining Communities

A livelihood is the means, activities, entitlements and assets by which people make a living, which is immediate and continuous, not necessarily for mine closure. It is also a framework that seeks to build the capacity of people to continuously make a living and improve their quality of life without jeopardizing the livelihood option of others, either now or in the future by coping and adaptive strategies (Temeng and Abew, 2009).

Within the mining sector, the livelihood concept has been adapted and defined as alternative livelihoods (AL), which are projects that are primarily aimed at compensating and re-establishing those who have been relocated or adversely affected by mine activities. Alternative livelihoods are basically defined as projects or activities' not relating directly to the primary business of the companies in Ghana's mining industry (Temeng and Abew, 2009).

Mining companies are not willing to assume the traditional functions of government in providing general services to their areas of operation but these companies are increasingly pressured by growing international advocacy groups to minimise the negative impacts of mining activities on the environments and the local people. In recognition of the scale of impact of mining activities on the livelihood of local inhabitants in the project area and the fact that mining companies could not provide the needed direct employment to most of the local youth, the companies are obliged to consider other alternative means for contributing to the community needs (Temeng and Abew, 2009).

2.7.2 The Reality of ALPs in Mining Communities in Ghana

In 2005, Newmont initiated a US$6 million private-sector-led "alternative livelihoods" project called the Livelihood Enhancement and Community Empowerment Program (LEEP) as an attempt to mitigate the loss of livelihoods caused by the project's displacement of thousands of poor farmers (Armstrong, 2008). LEEP was designed and is currently being implemented for Newmont by a Non-Governmental Organisation named Opportunities Industrialization Centres

International (OICI). The program promotes local production of so-called "demand-driven" commodities as an alternative to farming (Armstrong, 2008).

In addition to LEEP, Newmont agreed to come up with a US$4 million "Agricultural Improvement and Land Access Program" just one week prior to the Bank's approval of the loans. The main focus of the Agricultural Improvement and Land Access Program was to maintain or exceed pre-Project levels of crop productivity and ensure compensated farmers have access to land (Armstrong, 2008). This was to be accomplished by:

- Providing, free of charge, improved agricultural inputs, sufficient for two acres, for one crop season, to every person compensated by Newmont Gold Ghana Limited (NGGL) for cropped land in the Mine Take Area, and that has arable land of two or more acres (Armstrong, 2008).
- Facilitating land access for every person compensated by NGGL for cropped land, and that, at present, does not have access to land for cropping, nor has access to less than two acres of arable land. When persons obtain access to at least two acres of arable land, they become eligible for two acre input packages (Armstrong, 2008).

CHAPTER THREE

MATERIALS AND METHODS

3.1 The Study Area

The study was conducted in the Obuasi Municipality located in the Southern part of Ashanti Region of Ghana between latitude $5^0$35N and $5^0$65N, and longitudes $6^0$35W and $6^0$90W. It covers a land area of 162.4 square km and there are 52 communities in the Municipality with 30 electoral areas, and one Urban Council. It is bounded on the south by Upper Denkyira District of the Central Region, East by Adansi South, West by Amansie Central, and North by Adansi North (Obuasi Municipal Assembly, 2006) (Figure 3.1 and 3.2).

3.2 Climate and Vegetation

The Municipality experiences semi-equatorial climatic conditions with a double maximum rainfall regime. Mean annual rainfall ranges between 125cm and 175cm. Temperatures are uniformly high all year with the hottest month being March when 30^0C is usually recorded. Mean average annual temperature is 25.5^0C. Relative humidity is highest (75% - 80%) in wet season (Obuasi Municipal Assembly, 2006).

The vegetation is predominantly a degraded semi-deciduous forest. The forest consists of limited species of hardwood, which are harvested as timber. The AngloGold Ashanti has maintained large tracts of teak plantation as green belts covering 12.10km^2 within its concession (Obuasi Municipal Assembly, 2006).

3.3 Relief and Drainage

Generally, the Municipality has an undulating terrain with more of the hills rising above 500 metres above sea level. The Municipality is drained by streams and rivers which include; Pompo, Nyame, Akapori, Wheaseammo and Kunka. All the rivers are almost polluted by mining and other human activities (Obuasi Municipal Assembly, 2006).

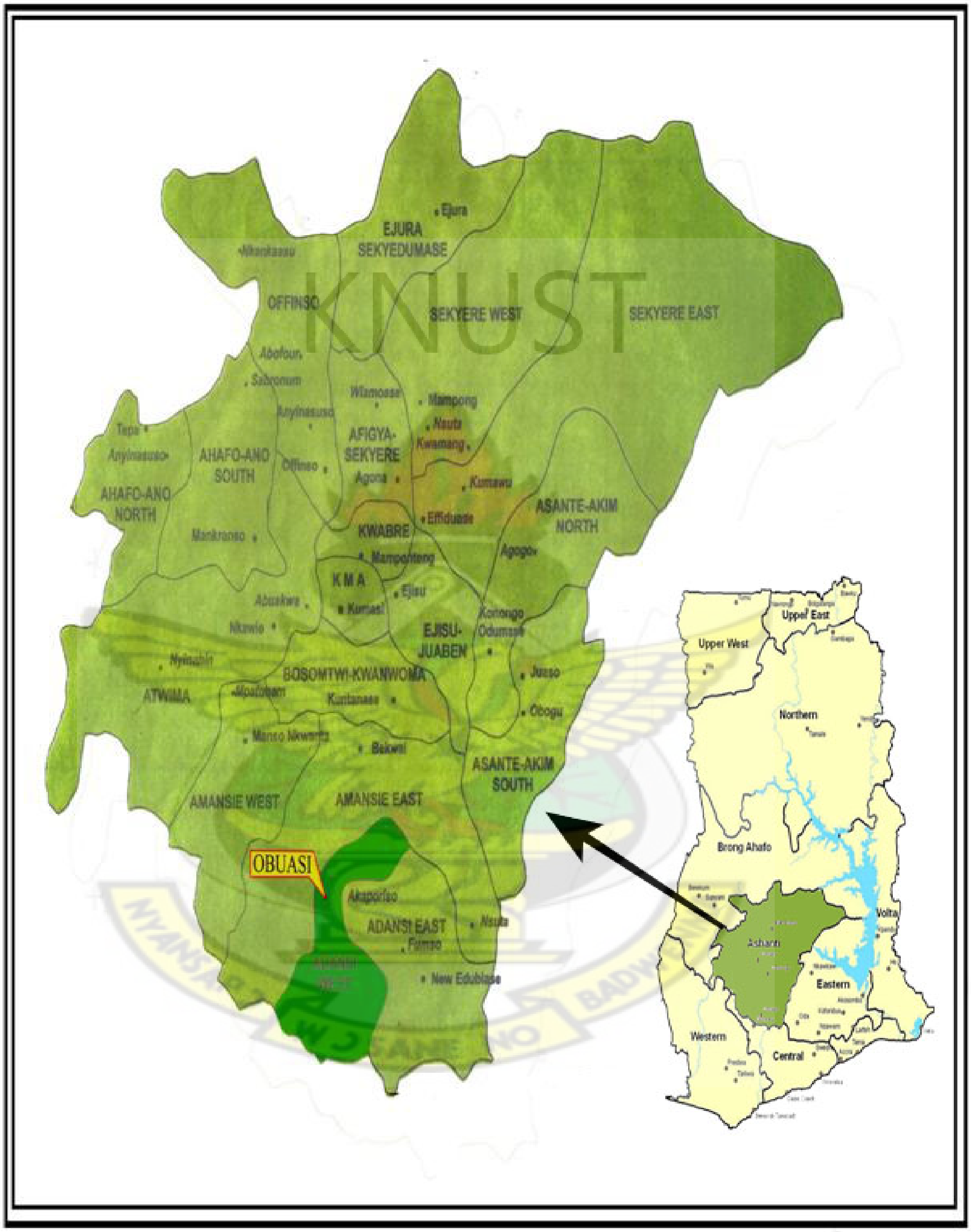

Figure 3.1 Map of Ashanti Region Showing Obuasi Municipality (Inset: Map of Ghana)

Source: Ghana Statistical Service (2002)

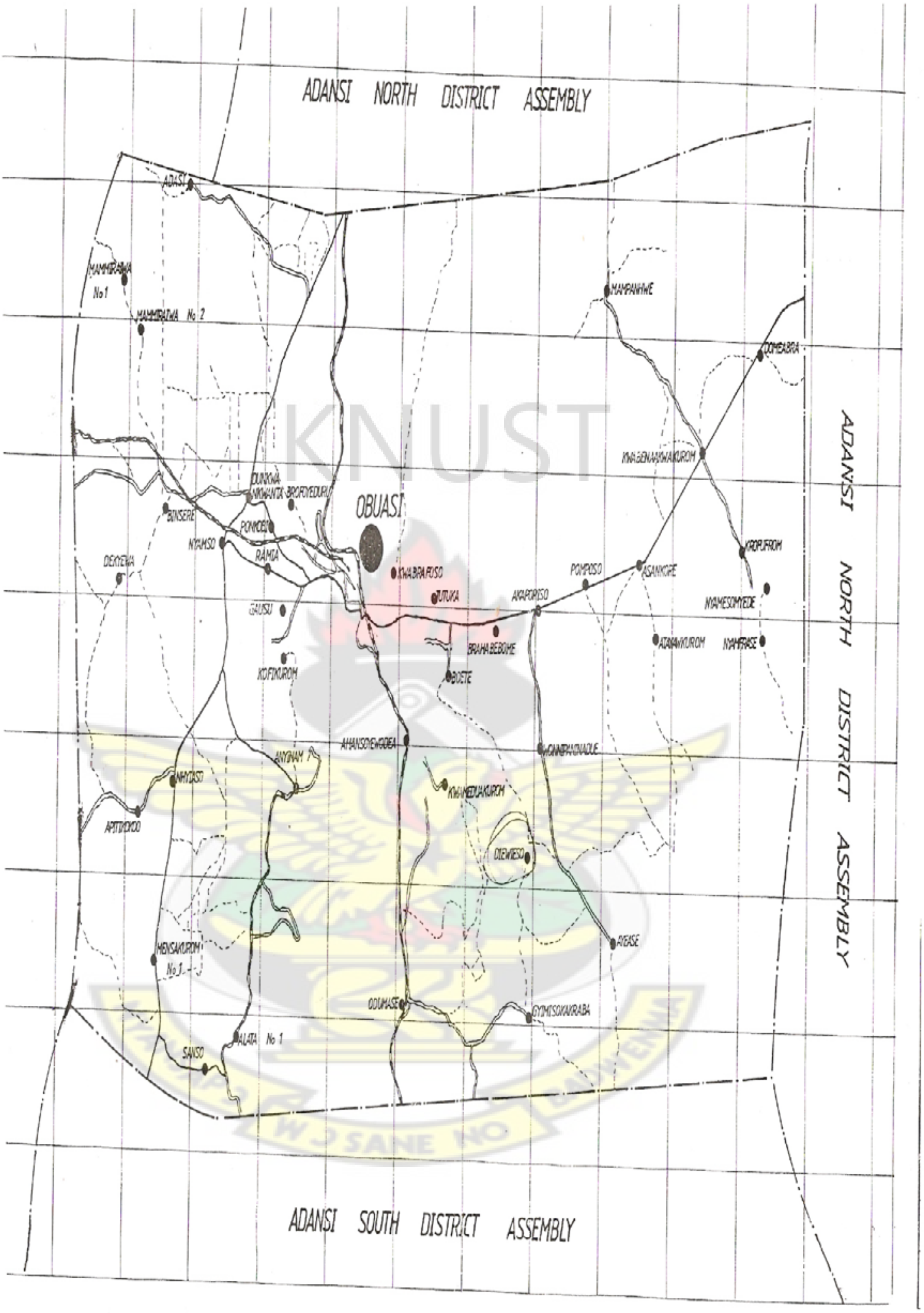

Figure 3.2 The Map of Obuasi Municipality

Source: Obuasi Municipal Assembly (2006)

3.4 Geology, Soils and Minerals

Rocks in the Municipality are mostly of Tarkwain (Pre-cambian) and Upper Birimian formation which are noted for their rich mineral bearing potentials. Areas around the contacts of the Birimian and Tarkwain zones known as reefs are noted for gold deposits. The Obuasi mine (AngloGold Ashanti) which works on steeply dipping quartz veins over a strike length of 8km, has since 1898 produced over 600 tons (18 million ounces) of gold from ore averaging about 0.65 ounces per ton (Obuasi Municipal Assembly, 2006).

These lands are considered moderately good for cropping and they carry soils which are generally medium textured, highly or moderately gravelly (Juaso series) or deep and non-gravelly (Bompata and Mawso series). They may be well, moderately well or imperfectly drained and occur on gently undulating topography (3-8% slopes) where susceptibility to erosion is relatively slight to moderate if mechanically tilled and carefully managed. Narrow bands of very deep non-gravelly soils (Asuboa series) occupy lower slopes (2-5%) and drainage grooves. Water-holding capacity is moderate although surface layers are liable to dry out in dry seasons. The upland and slope soils are recommended for all the tree and arable crops such as cocoa, coffee, citrus, oil palm, avocado, guava, cola, mangoes, maize, cassava, yams, cocoyam, plantain, banana, pawpaw and all kinds of vegetables, sugarcane, groundnuts and pineapple. The lowland soils (Pamasua and Dambia series) are recommended for rice, sugarcane and vegetables (Adu, 1992).

3.5 Demographic Characteristics

According to the recent survey conducted by the Ghana Health Service and projections from the 2000 Population and Housing Census, the population of the Municipality as at the end of 2005 was 195,000 with 90% of the population dwelling in the urban areas while 10% is rural. The annual growth rate in the Municipality is about 4.0% resulting from teaming migrants who are in search for jobs with the mining and other related companies (Obuasi Municipal Assembly, 2006).

There are 52 communities which make up the Municipality and due to limited land area, 94% of the population in the Municipality is concentrated along major roads which run in the valley flanked by high hills. The population density of the area is 1,201 persons per square km. This really puts a lot of pressure on socio-economic facilities and land for both housing and other economic activities. According to the 2000 Population and Housing Census, there are 24,729 households in the Municipality with an average housing occupancy of 11.8 persons. The composition and structure of household in the Municipality are a reflection of the social structure of the Ghanaian society. The extended family system is a predominant family set up in the Municipality (Obuasi Municipal Assembly, 2006).

According to the 2000 Population and Housing Census, the population distribution of the Municipality shows that about 48% of the population is in dependent age groups, that is between 0-14 years and the remaining 52% constitute the potential labour force. This gives age-dependency ratio of about 1:1 implying that every person in the working age group takes care of himself/herself and an additional person (Obuasi Municipal Assembly, 2006).

There is abundant labour force in the Municipality. According to the 2005 population estimates, the active population stood at 93,600. This huge labour force is made up of diverse skills at various levels as a result of mining and allied industrial activities in the Municipality which continue to attract and retain labour. In the municipality, the service and commerce sector take the lead in terms of economic activities, followed by mining/industry and lastly, agriculture. The service sector which includes transport, telecommunication, banking, insurance, trading and mining support activities engages about 55% of the working population while mining/industry employs about 35% and agriculture engages 25% (Obuasi Municipal Assembly, 2006).

3.6 Data Collection

The study employed both primary and secondary sources of data collection. The primary sources of data collection involved reconnaissance survey, administration of structured questionnaire to sampled respondents from households, field visits and observation, and target group discussion with opinion leaders in the various communities. Also questionnaire was administered to and discussions held with the Community Relations and the Environmental Managers of AngloGold Ashanti.

Familiarization and reconnaissance survey was undertaken in the seven randomly sampled communities prior to the main data collection. It was also used to mobilise logistical support, establish needed contacts and protocols for further communication, prepare itinerary for field operations and pre-test the questionnaire.

The secondary sources involved extensive review of literature of existing reports and works, books, articles, and many other already established facts. The study was undertaken on community basis (micro-level) but scaled up with secondary information from the municipal, regional and national levels.

3.6.1 Sampling Techniques

Random and purposive sampling techniques were used in this study. Thirteen communities whose land use systems and livelihoods have been impacted by mining activities were purposively selected from the 52 communities in the municipality.

Seven out of thirteen purposively sampled communities were randomly selected due to time and logistical constraints encountered. Seventy-eight farmers were sampled to assess the impact of mining on their land use systems whiles 145 respondents were sampled to determine the impact of mining on the livelihoods of the communities. Therefore a total of 223 respondents were sampled from the seven communities. According to Diaw *et al*., (2002), sample sizes depend on the size of the local population. A community with a population of less than 500, 10% sampling intensity is used. Also those with populations between 500 to 1000, 5% sampling intensity is used and 2.5% sampling intensity is used for communities with a population above 1000. A larger number of respondents would have been sampled using Diaw's formula but this was reduced to 223 respondents because of logistical and time constraints, and the homogenous nature of the municipality.

Opinion leaders, Community Relations and Environmental Managers of AngloGold Ashanti and key informants were purposively sampled. Key informants were persons from the sampled communities who had vast knowledge of the community and the importance of the research. These key informants provided lots of in-depth and proficient information and directed the researcher through the communities to undertake the study. Opinion leaders not only provided insight, but also were residents and therefore part of the relevant sample. Opinion leaders are local political figures and thus might have special insights about the impacts of mining on their communities than perhaps average residents (Aubynn, 2003). Also most mining companies in Ghana deal with communities through elected and/or appointed leaders. Residents of mining communities most often direct their concerns to mining companies through opinion leaders. Therefore, opinion leaders had in-depth knowledge on residents concerns about mining activities in the community. Opinion leaders also had relatively more knowledge about AGA's assistance to the communities than the other residents therefore their inclusion enhanced the richness and depth of information received about the impact of mining on the communities.

3.6.2 Data Analysis and Analytical Tools

Data collected was analysed with Statistical Package for Social Scientists (SPSS). Descriptive statistics and multiple response tools were used for the data analysis. Descriptive statistics tools like frequencies, cross tabulation, percentages, means and standard deviation were used for the analysis. In addition, multiple response tools like frequency and percentage were also used to analyse multiple responses by the respondents.

3.7 Limitations of the Study

There was lack of co-operation on the part of some sampled respondents due to past experiences. According to some of the community members, AngloGold Ashanti and some agencies have conducted similar interviews, but had failed to respond positively to the concerns of the communities. Because of this, some of the respondents were unwilling to co-operate. Some accepted only after minutes of explanation with the help of the key informants.

The study employed the estimations of community members' whiles actual measurements of certain parameters were not carried out. Hence the estimation of the previous and recent average annual yields of farmers were based on respondents own estimation and not on any actual measurements. Therefore there is the tendency for respondents to make errors in the estimation of their average annual yields.

The quality of some responses received was affected by the low educational level of some of the sampled respondents. Because of that, most of the respondents had to be guided by citing certain examples to obtain the required information from them to eliminate bias. It was also observed that most females did not have in-depth knowledge and information about their communities compared to their male counterparts and some refused to contribute because their male partners were not available.

Research of this scale and extent requires substantial resources in respect of time and money. Commercial vehicles commuting between some of the sampled communities and the part of Obuasi where the researcher resided were mostly unavailable around evening times especially after 4-5 p.m., which was a favourable time to meet most of the heads of households who returned home from work. Therefore some difficulties were encountered in reaching some of the intended respondents because researcher had to leave early with the available vehicles. For that reason, the number of days spent in those communities was extended to overcome the difficulties.

CHAPTER FOUR

RESULTS AND DISCUSSION

4.1 Introduction

This chapter presents the results and discussion of the field survey. The first part focuses on the demographic characteristics of sampled respondents such as gender and age distribution, marital status, educational background, occupation, origin and farming experience of respondents. This is followed by the identification of land use systems and the impact of mining on the land use systems and livelihoods in the municipality.

4.2 Socio-economic Characteristics of Respondents

4.2.1 Gender and Age Distribution of Respondents

The gender distribution of sampled respondents had an approximate ratio of 4:1 i.e. 78.84% males to 21.52% females (Table 4.1).

Table 4.1: Gender Distribution of Respondents

Gender	Number of Responses (N=223)	Percentage (%)
Male	175	78.48
Female	48	21.52
Total	223	100

According to Masterson (2007), women are much less likely to own land in much of the world. In subsistence agriculture, particularly in Africa, food production is mainly done by women, with little from men and in Ghana, smallholdings kept by women provide about 80% of the total food production in the country (Ogunlela and Mukhtar, 2009). Cultivation of cash crops and other heavy work such as ploughing are carried out by men while food crops and lighter works such as weeding are often women’s responsibility (Fakoya *et al*., 2006). This was confirmed since tree crop farming systems was widely practiced compared to the food crop farming system possibly because there were more male farmers than female farmers in the communities.

The age distribution of respondents was categorised into five groups: 20-30, 31-40, 41-50, 51-60 and above 60 years age groups. The 41-50 year group constituted the bulk of the respondents (26.91%), followed by the 31-40, 20-30 and above 60 years age groups with 23.32%, 20.63% and 14.79% of respondents respectively. The 51-60 year group (14.35%) had the least number of sampled respondents (Table 4.2).

Table 4.2: Age Distribution of Respondents

Age Groups	Number of Responses (N=223)	Percentage (%)
20-30	46	20.63
31-40	52	23.32
41-50	60	26.91
51-60	32	14.35
Above 60	33	14.79
Total	223	100

NOTE: Standard Deviation: 15.07; Average Age (years): 44.45; Age Range (years): 20 -105

Results obtained indicates that majority of the respondents were in the active age group i.e. 20 to 60 years and can therefore be regarded as active, agile and physically disposed to pursue economic activities. This group of respondents was engaged in most livelihood activities in the communities. According to Uddin (2008), age of a person is a crucial determinant of the ability to perform a job and young people can better apply their eagerness, dedication, consciousness and motivation towards achieving a target successfully. So age structure of the members is very important in the context of their ability to get out of poverty. Results of studies conducted by Iheke (2008) indicated that age is negatively related to output, and the negative relationship implies that with advance in age, output decreases due to decline in the ability to do manual work. From the study, few respondents (14.79%) were above 60 years and productivity of some farmers in this age group declined because of their advanced ages and inability to effectively undertake manual work.

4.2.2 Educational Statuses of Respondents

Education is the foundation in which human qualities are built (Uddin, 2008). The educational statuses were determined in terms of the highest educational level reached by respondents. Majority of the respondents had received different levels of education (91.93% - combined percentage), whiles a minority (8.07%) had received no education. For the majority who have been educated, a greater percentage have been educated to the JHS level (57.40%), followed by the Primary School level (21.97%) and the SHS/Vocational level (Table 4.3).

Although the majority of respondents had been educated, almost all of them could not communicate in the English language and only preferred the local dialect (Twi). Economic benefits of schooling include the potential to obtain paid employment or to generate income through self-employment using skills learned in school (Weir, 1999). In theory, education is expected to improve productivity in all spheres of activities including agriculture (Asadullah and Rahman, 2005).

Table 4.3: Educational Statuses of Respondents

Educational level	Number of Responses (N=223)	Percentage (%)
Senior High School/Vocational	28	12.56
Junior High School/Middle	128	57.4
Primary School	49	21.97
Illiterate	18	8.07
Total	223	100

According to Adebiyi *et al*., (2009), an increase in the number of years in education attainment will increase the probability of being food secure because with increase in the level of education, farmers will be able to adopt more modern farm technologies on their farms thus improving their productivity. Education may enhance farm productivity indirectly by improving the quality of labour, by increasing the ability to adjust to disequilibria, and through its effect upon the propensity to successfully adopt innovations (Weir, 1999).

4.2.3 Marital Statuses of Respondents

Marriage is socially defined as to include formal unions that are legally, traditionally or religiously sanctioned as well as informal cohabiting unions (Amonoo, 2006). From the survey, majority (75.35%) of respondents were married. This was followed by single, divorced and widowed respondents with 18.83%, 3.14% and 2.69% respectively (Table 4.4).

Table 4.4: Marital Statuses of Respondents

Marital Statuses	Number of Responses (N=223)	Percentage (%)
Single	42	18.83
Married	168	75.34
Divorced	6	2.69
Widowed	7	3.14
Total	223	100

From the survey, most farmers in the communities were married and according to results of a study by Oladele (2007), the fact that the majority of farmers were married shows that couples engaged in cooperative effort in farming activities or operations and farm families use mainly household head, wives, children and relations. Results of a study by Adebiyi *et al*., (2009) also indicated that most respondents were married and according to him, the findings imply that there is the possibility of more availability of family labour.

4.2.4 Origin of Respondents

The bulk of respondents (52.02%) were not natives of the various sampled communities whiles natives formed 47.98% of the total respondents (Table 4.5). To explain this, Nyame and Grant (2007) stated that macro-level models predict that labour will flow from ‘labour-abundant’ regions or countries to ‘labour-scarce’ ones in order to secure higher wages on offer.

Table 4.5: Origin of Respondents

Origin	Number of Responses (N=223)	Percentage (%)
Native	107	47.98
Non-native	116	52.02
Total	223	100

During the development phase when ore has been delineated and ready to be mined at a profit, demand for all forms of labour from skilled to unskilled tends to be high, qualitatively in conformity with the volume and quantum (or diversity) of work required. This phase, therefore, attracts maximum labour of all kinds often equalled only when existing mines undergo massive expansion projects (Nyame and Grant, 2007). Therefore the larger number of non-natives in the communities can be explained with the above assertion. These non-natives were from all the regions of Ghana except the Brong-Ahafo Region (Table 4.6).

Table 4.6: Regional Origins of Non-natives

Region of Origin	Number of Responses (n=116)	Percentage (%)
Ashanti	71	61.22
Central	12	10.34
Upper West	11	9.48
Northern	8	6.90
Eastern	6	5.17
Volta	4	3.45
Western	2	1.72
Upper East	1	0.86
Greater Accra	1	0.86
Total	116	100

4.2.5 Occupation of Respondents

According to Amonoo (2006), the four major occupations, in Ghana, are agriculture and related work (49.2%), production and transport equipment work (27.7%), sales work (14.2%) and professional and technical work (8.9%). The survey revealed that the major occupation of respondents was farming which accounted for 54.26% of all the occupations. This was followed by the unemployed respondents (11.21%) and others (10.31%) i.e. labourers, electricians, seamstresses, drivers, hair dressers and carpenters etc (Table 4.7). Results of this study confirm the facts by Amonoo (2006) since most respondents in the communities engaged in farming/agriculture as their livelihood activity.

Respondents involved in mining or mining related work were made up of Private securities, illegal/"galamsey" miners and AGA miners. Among these three groups, the bulk of respondents were employed as private security (8.52%), followed by the illegal miners (4.93%) and AGA miners (2.69%). The private securities are respondents who have been employed by several companies contracted by AngloGold Ashanti to guard their properties and places of operation in the various communities. Example of such companies includes MBC (Mining and Building Company), Atlas Copco and Sandvik etc.

Table 4.7: Occupation of Respondents

Occupation	Number of Responses (N=223)	Percentage (%)
Farming	121	54.26
Unemployed	25	11.21
Others	23	10.31
Private security	19	8.52
Trading	15	6.73
Illegal mining	11	4.93
AGA miners	6	2.69
Government work	3	1.35
Total	223	100

Results obtained indicate that the unemployment rate in the communities was quite high (11.21%). This was because; most of the unemployed respondents were looking forward to being employed by AGA rather than engaging in other forms of livelihood activities. Some of the unemployed respondents were employees of AGA but were discharged off their duties, and according to Nyame and Grant (2007), mining companies may restructure or downsize as a consequence of stagnation and decline in economic activity or just to take advantage of new mining and processing technology in order to stave off competition.

4.2.6 Respondents Farming Experience

Farming experience corresponds to the number of years one has been engaged in farming as a livelihood activity. The farming experience of the respondents was categorised into 5 year groups: 1-10, 11-20, 21-30, 31-40 and 41-50 year groups. The bulk of the respondents (37.18%) had farmed from 1-10 years followed by 11-20 and 21-30 year groups with a percentage of 25.64% and 24.36% respectively. The 31-40 and 41-50 year groups had very few numbers of respondents with a percentage of 8.97% and 3.85% respectively (Table 4.8).

Table 4.8: Respondents Farming Experience

Years	Number of Respondents (n=78)	Percentage (%)
1-10	29	37.18
11-20	20	25.64
21-30	19	24.36
31-40	7	8.97
41-50	3	3.85
Total	78	100

Results obtained imply that most farmers have had many years of practical experience in farming. According to Oladele (2007), experience contributes to farmers' ability to improve on their farm operations or activities. Similarly results of studies conducted by Iheke (2008) indicated that farmers would count a lot more on their farming experience for increased productivity. Farming experience can generate or erode confidence in new technology. With more experience, a farmer can become more or less risk-averse when judging new technology (Ajewole, 2010).

4.3 Farming Systems Practised by Farmers

From the survey, four different farming systems were indentified: namely cocoa, oil palm, citrus and food crop farming systems. The cocoa farming system was most widely practised (43.31%), followed by oil palm farming system (29.92%). Also 24.41% of farmlands were used for food crops farming system whiles citrus farming system had the lowest number of farmlands (2.36%) (Table 4.9).

Table 4.9: Farming Systems Identified

Farming Systems	Number of farmlands	Percentage (%)
Cocoa farming system	55	43.31
Oil palm farming system	38	29.92
Citrus farming system	3	2.36
Food crop farming system	31	24.41
Total	127	100

NOTE: Most farmers practised more than one farming system.

For each of the farming systems identified, farmers were practising either mono cropping or mixed cropping systems (Table 4.10).

Table 4.10: Details of the Farming Systems Identified

Farming Systems	Cropping Pattern	Number of farmlands	Percentage (%)	Total land area (hectares)	Average land size (hectares)
Cocoa	Mono cropping	22	17.32	52.41	2.38
	Mixed cropping	33	25.98	69.61	2.11
Oil palm	Mono cropping	27	21.26	43.50	1.61
	Mixed cropping	11	8.66	11.94	1.08
Citrus	Mono cropping	1	0.79	1.62	1.62
	Mixed cropping	2	1.58	2.63	1.32
Food crop	Mono cropping	4	3.15	2.43	0.61
	Mixed cropping	27	21.26	24.28	0.90
Total		127	100	208.42	11.63

The classification of the farming systems was confirmed by Izamuhaye (2008), who stated that the classification of the farming systems of developing regions can be based on criteria related to cultivation including; type of rotation (annual, perennial crops, etc), intensity of rotation, water supply, cropping pattern and animal activities, implements used for cultivation and degree of cultivation.

4.3.1 Cocoa Farming System

Cocoa farming system was the most widely practised farming system (43.31%). Mixed cropping system was practised on 25.98% of farmlands whiles 17.32% was for the mono cropping system. According to Gockowski (1999), the majority of smallholder producers of tree crops in West and Central Africa, however, belong to the “mixed” farming group and are not solely dependent on tree crops for their rural livelihood. For the mixed cropping system, plantain was the most common food crop mixed on 39.47% of cocoa farmlands, followed by cassava (28.95%), cocoyam (15.79%), pineapple (3.94%) and maize (3.94%). Yam, orange, oil palm and water yam had the least percentage of 1.32% each, meaning few cocoa farmlands was mixed with these crops (Appendix 5). In Ghana, plantain belongs to the non-traditional sector of the rural economy, where it is used mainly to shade cocoa and is also an essential component of the diet (Dzomeku *et al*., 2007). Cocoa farming system had the largest average land sizes for both mono and mixed cropping systems; 2.38ha and 2.11ha respectively and according to Gockowski *et al*., (2004), the majority of cocoa farmers in West Africa are smallholders, with 22 percent of cocoa produced on farms of less than two hectares, 65 percent on farms of between two and ten hectares and only 12 percent on plantations of more than ten hectares.

4.3.2 Oil Palm Farming System

For oil palm farming system, more farmlands (21.26%) were for mono cropping whiles 8.66% of farmlands were used for mixed cropping pattern. Average land size for the mono cropping system (1.61ha) was also larger than the 1.08ha land size for the mixed cropping system. Crops mixed with oil palm were cassava, plantain, cocoa, cocoyam, orange and pineapple. Majority of farmlands (40.90%) were mixed with cassava, followed by plantain (27.27%), cocoa (13.64%) and pineapple (9.09%). Orange and cocoyam had the least percentage of 4.55% each (Appendix 5). This was affirmed by Amoah *et al*., (1995), who stated that during the establishment of these tree crops farmers traditionally intercrop with food crops such as plantain, maize, cassava, cocoyam, pepper and many other annual crops, as a cultural practice for income to offset part of initial tree crop development outlay or as a source of food sustenance to the farmer.

4.3.3 Citrus Farming System

Sweet orange (*Citrus sinensis*) is the only citrus species grown by the farmers and mixed cropping is widely practised compared to mono cropping pattern. Mixed cropping was practised by two farmers whiles one farmer practised mono cropping system. Average land sizes for both mono and mixed cropping patterns were 1.62ha and 1.32ha respectively. Crops mixed with the citrus tree crops were oil palm, cassava and pineapple (Appendix 5).

4.3.4 Food Crop Farming System

Under the food crop farming system, 27 (21.26%) farmlands were under mixed cropping whiles 4 (3.15%) farmlands were used for mono cropping system. This was affirmed by Malézieux *et al*., (2008) who stated that majority of the world's farmers, particularly those located in tropical regions; still depend on multispecies agricultural systems for their food and income, i.e. the cultivation of a variety of crops on a single piece of land. Three different crops were cultivated under the mono cropping system namely; yam, okro and cassava (Appendix 5). For the mixed cropping system, various crops like plantain, cassava, pineapple, cocoyam, maize, water yam, pepper and yam were cultivated by farmers practising this system. Cassava and plantain were the most common staple crops cultivated by farmers and each crop occupied 30.86% of farmlands under this system. This was followed by cocoyam, maize, yam and pineapple with 19.75%, 9.90%, 3.70% and 2.47% respectively. Pepper and water yam were the least cultivated food crops, and each crop occupied 1.23% of farmlands under the system (Appendix 5). Cassava and plantain were the most common staple food crops and according to Dahniya (1994), cassava can grow on a wide range of soils and can yield satisfactorily, even on poor acid soils where most other crops fail, therefore, the crop plays a vital role in alleviating famine by providing sustained food supplies when other crops fail. Sharrock and Frison (1999) also indicated that Bananas and plantains are popular for many reasons; they are one of the cheapest foods to produce. The cost of production of one kilogram of plantain for example is less than most other staples, including sweet potato, rice, maize and yam. They also grow in a range of environments and produce fruit year-round, thus providing a source of energy when other crops are not available.

4.4 Sources of Water for Farming

From the survey, the bulk of farmers (69.23%) depended on only rainfall as their source of water for farming. This was followed by 24.36% of the farmers who used rainfall and stream/river and 5.13% who depended on rainfall and borehole for crop production. The use of rainfall and pipe-borne water for crop production had only one farmer (1.28%) (Table 4.11). The majority of the population of Sub-Saharan Africa depend on subsistence rain-fed agriculture (Ngigi, 2009). According to Rockstrom *et al*., (2007), majority of poor people in the world are dependent on rain-fed agriculture for food, incomes, and thus livelihood security.

Table 4.11: Sources of Water for Farming

Sources of water	Number of Respondents	Percentage (%)
Rainfall only	54	69.23
Rainfall and Stream/River	19	24.36
Rainfall and Pipe-borne water	1	1.28
Rainfall and Borehole	4	5.13
Total	78	100

This therefore explains why majority of farmers depended on only rainfall as a source of water for farming. From the survey, it was revealed that farmers who depended on the stream/rivers used it mainly for the spraying of their cocoa farms, since fetching water from the communities to the farmlands was nearly impossible due to the distance they had to walk.

4.5 Problems with Sources of Water

Majority (67.95%) of farmers had no problem with the availability and quality of their sources of water. This was due to the fact that, most of the respondents depended on rainfall only and had the perception that mining activities does not pollute their source of water. Farmers, who had problems (24.36%), attributed the problems to the chemical pollution of the rivers or streams. The remaining 7.69% of farmers were not sure about the state of their sources of water for farming.

In relation to this problem, the Environmental Manager of AGA explained that the Company sometimes faces problems with the management of the tailings dam especially in the rainy seasons where precipitation is higher than evaporation. So some percentage of the tailings is treated through certain chemical reactions to precipitate and remove arsenic and cyanide and the treated water is discharged into water bodies. Based on this, there is the tendency for certain water bodies to be polluted if certain chemicals are not satisfactorily removed.

4.6 Effects of Polluted Water Use on Crop Production and Productivity

Farmers, who had problems with water quality, disclosed the effects of the use of the polluted water on the crop production and productivity. Most farmers (37.50%) reported of low yields. Other problems faced by farmers included stunted growth of crops (18.75%), yellowing and dying of crops before maturity (18.75%) and rotting of crops before maturity (15.63%). Few farmers (9.73%) had not detected any problems from the use of the streams or rivers for crop production (Table 4.12). According to Chaturvedi (2006), biomass production and yields of a variety of crops are reduced significantly at elevated arsenic concentrations and also understanding how arsenic is taken up by plants and subsequently transformed in plant tissue is therefore essential for estimating the risks posed to human and wildlife populations by arsenic contaminated soils.

Table 4.12: Effects of Polluted Water Use on Crop Production and Productivity

Reason(s)	Number of Responses (n=19)	Percentage (%)
Crops turn yellowish and die before maturity	6	18.75
Low crops yields	12	37.50
Pods/Fruits rot before maturity	5	15.63
Stunted growth of crops	6	18.75
No problem detected	3	9.37
Total	32	100

NOTE: Some respondents selected more than one answer (Multiple responses)

4.7 Effects of Mining on Crop Production and Productivity

From the survey, majority (74.36%) of farmers have recorded reduction in crop yields over an average period of 12 years whiles 25.64% have not recorded any reduction in crop yields. According to Dixon *et al*., (2001), the functioning of any individual farm system is strongly influenced by the external rural environment, including policies and institutions, markets and information linkages; hence several factors can cause the reduction of crop yields over time.

To determine the extent of yield change over time, an effort was made to determine the previous and recent average annual yields of all farmers interviewed. Most farmers engaged in cocoa and citrus farming were able to estimate their average annual yields with the exception of a few whose tree stock were not fully matured for production. Farmers in the communities started their farming activities at different years so it was difficult to use a specific time frame to estimate the previous annual average crop yields. Estimation of previous yields was based on the average annual yields of crops before farmers observed decline in crop productivity whiles recent yields was also based on the recent average annual yields of farmers. According to Amoah *et al*., (1995), the yields of oil palm is defined by the number of bunches and the total weight of bunches per hectare but farmers into oil palm and food crop production were not able to estimate their yields because yields obtained from this farming systems were not quantified.

From the survey, most of the cocoa farmers have recorded a reduction in their average annual yields with time. Based on the cocoa farmers own estimation, previous average annual yields of 207.25kg/ha has reduced to 98.03kg/ha over the years (Figure 4.1). According to Bosompem *et al*., (2006) the average national annual yield of cocoa in Ghana is 350kg/ha, therefore recent yields/ha (98.03kg/ha) of cocoa produced in the mining communities was less than the average national annual yields.

The average age of the cocoa stands in the communities was approximately 23years with the ages ranging from a minimum of 4years to a maximum of 45years (Appendix 6). According to Anim-Kwapong and Frimpong (2005), about 25% of current cocoa-tree stocks are over 30 years old and over 60% of cocoa farmers are currently over 50 years old, and unwilling to take extra risk in investing in yield improvement strategies due to perceived high cost of input relative to producer price.

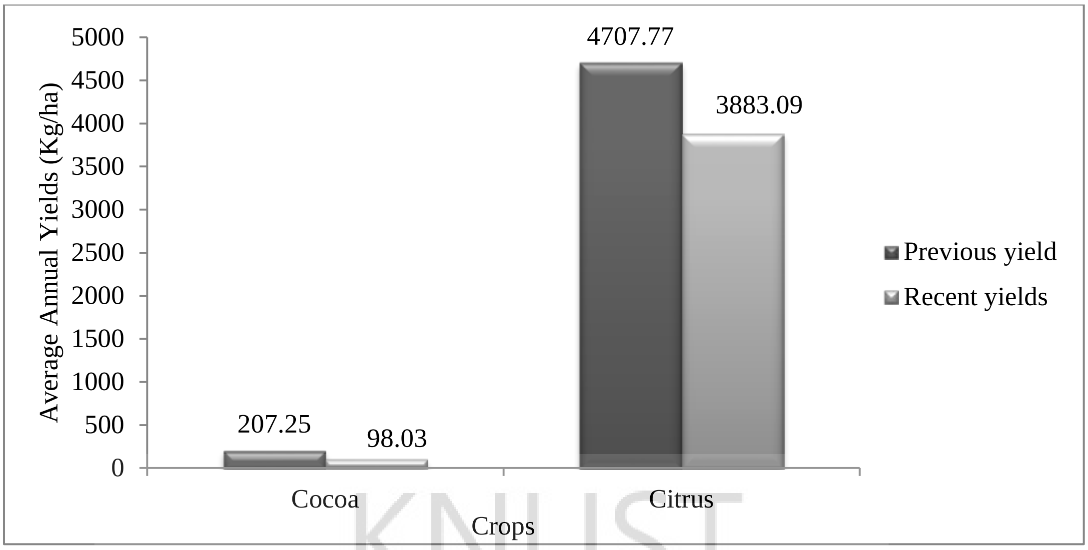

Figure 4.1 Respondents Estimation of Average Annual Crop Yields in AGA Mining Communities

Olaiya *et al*., (2006), stated that highest cocoa yields are achieved between 15 and 25 years and that a profitable life span may be 50 years, but that from the 26th year yields decline gradually and production costs rise steadily. Therefore with the average age of the cocoa stands being 23years, one would have expected average annual yields to have been increasing but rather there was a reduction. The average farmland size for the cocoa production was 2.56ha with individual land sizes ranging from 0.2ha to 13.13ha (Appendix 6). This was affirmed by Gockowski *et al*., (2004)**,** who stated that majority of cocoa farmers in West Africa are smallholders, with 22 percent of cocoa produced on farms of less than two hectares, 65 percent on farms of between two and ten hectares and only 12 percent on plantations of more than ten hectares**.**

Likewise for the citrus farming system, average annual yields reduced from level of 4706.77kg/ha to 3883.09kg/ha. Raemaekers (2001) stated that when all varieties of citrus are lumped together, an average yield of 30,000kg/ha is expected from an orchard in full production. Average size of farmlands for citrus farming was 1.72ha with individual sizes ranging from 0.61ha to 2.83ha and the average age of the citrus stands was 15years. According to Adu (1992), no large-scale citrus plantations exist within the Ashanti Region but there are a number of small orchards seen here and there and most villages have a few trees around them.

4.7.1 Factors Responsible for Crop Yield Reduction

Majority (93.10%) of farmers attributed the reduction of their crop yields to the presence of mining activities in the community whiles 6.90% of farmers attributed their reduction to other factors aside the mining activities. Farmers who did not attribute their crop reduction to mining activities gave reasons of poor management of farm due to poor health and old age whiles other farmers were not sure of factors that caused the yield reduction.

Farmers who attributed their yield reduction to mining activities gave several reasons to justify their claims. The bulk of them (31.15%) attributed the reduction to the destruction of parts of their farmland, followed by air pollution (24.59%) and pollution from the tailings dam (21.31%). In addition 14.75% of respondents attributed it to the degradation of land, followed by flooding of farmlands from diverted river channels (6.56%) and parts of farmlands taken over by AGA (1.64%) (Table 4.13).

From the survey, farmers who suffered from the destruction of farmlands indicated that this was mostly caused by movement of AGA's earth moving equipments through their farmlands (Plate 4.1). Air pollution effects according to farmers, originated from the Sulphur Treatment Plants (at Sansu and Anyinam) and from the tailings dam at Dokyiwaa. For the land degradation problem, it was revealed that this was caused by the erosion of polluted soils from previously mined areas unto nearby farmlands. According to U.S. EPA (1997), because of the large area of land disturbed by mining operations and the large quantities of earthen materials exposed at sites, erosion can be a major concern at mining sites. Under this same problem, farmers indicated that some of their farmlands are located at previously mined sites and crop productivity at those sites is low because of land degradation problem.

Table 4.13: Causes of Crop Yield Reduction due to Mining Activities

Causal factors	Number of Responses (n=54)	Percentage (%)
Destruction of farmlands	19	31.15
Air pollution	15	24.59
Land degradation	9	14.75
Pollution from tailing dam	13	21.31
Flooding of farmlands from diverted river channels	4	6.56
Parts of farmlands taken over by AGA	1	1.64
Total	61	100

NOTE: Some farmers gave more than one response (multiple responses)

Plate 4.1 Destruction of a Portion of a Cocoa Farm by Earth Moving Equipments

Source: Field survey, April/May 2010.

Tailings pollution of farmlands originated from the tailings dam and according to farmers, spigot pipes that link the dam sometimes break, introducing polluted waste water into farmlands. Other farmers asserted that the tailings in the dam seep into the ground and surfaces in their farms causing considerable damage to their crops. This was because some farmlands located in Dokyiwaa, Binsere and Apitikoko were located near the Sansu tailings dam thereby exposing them to this problem (Plate 4.2). According to Gawu (2009), due to the high pH of cyanide discharge from treatment plants, vegetation does not flourish in areas where these cyanide-rich tailings are located as can be seen at Obuasi.

Plate 4.2: An Oil Palm Farm Located Beside the Sansu Tailings Dam

Source: Field survey, April/May 2010

Flooding of farmlands according to farmers was caused by the diversion of some river channels and rivers overflowing their banks because of the mining activities. Farmers also reported that the discharge of tailings into rivers also caused the siltation of the water bodies and flooding of nearby farmlands. According to Hinton (2006), siltation of rivers caused by discharge of tailings into waterways reduces light penetration and dissolved oxygen levels, thereby jeopardizing fisheries, and may result in flooding; silt build-up may effectively modify the dimensions of drainages such that flooding occurs.

Based on the several problems encountered by farmers, why then should AGA allow farmers to farm on their concession lands since compensation are paid for impacted farmlands? This was because, farmers whose farmlands have been impacted in one way or the other by the mining activities complained about inadequate compensation payment by AGA. But according to the Community Relations Manager, "as long as mining activities have not started in all parts of the communities, the people have livelihoods so they have to go ahead and farm since they have surface right".

Majority (73.08%) of farmers indicated that based on present occurrences, they are at risk of losing their farmlands to AngloGold Ashanti, since some nearby farmlands have been compensated for and taken over the company. According to them, this has deterred them from making substantial financial investment in their farms since the farmlands can be taken over at any time with little compensation. The remaining 26.92% did not harbour any fears of losing their farmlands due to the locations of their farmlands in relation to farmers who have lost their farmlands. Therefore such farmers could easily invest in their farmlands with no immediate risk of losing those farmlands.

4.8 Effects of Mining on the Accessibility to Farmlands and the Transport of Farm Produce to the Communities

Mining activities generally did not interfere with farmers' accessibility and the transport of farm produce from farmlands to the communities. From the survey, most farmers (82.05%) had no difficulties accessing their farmlands and transporting farm produce to the communities while 17.95% encountered various forms of difficulties.

The accessibility difficulties caused by the mining activities, reported by some farmers are presented in Table 4.14. The bulk of farmers (57.14%) had difficulties with water logged and eroded routes linking their farmlands to the communities. According to these farmers, some narrow streams have been expanded by the mining activities thereby causing water logged routes. U.S. EPA (1997) stated that because of the large area of land disturbed by mining operations and the large quantities of earthen materials exposed at sites, erosion can be a major concern at mining sites. Some farmers (28.58%) also had difficulties with blocked footpath by AGA and these farmers had to take longer routes to their farmland. Excavation of pits by illegal miners on some routes linking farmlands was another problem faced by 14.28% of farmers.

Table 4.14: Problems of Accessibility to Farmlands by Farmers in AGA Mining Communities

Problems	Number of Respondents (n=14)	Percentage (%)
Water logged and eroded routes	8	57.14
Blocked footpath by AGA	4	28.58
Excavation of pits by illegal miners	2	14.28
Total	14	100

4.9 Effects of Mining on Employment and Standard of Living

4.9.1 Employment of Community Members

From the survey, 97.93% of respondents were aware of the employment of some community members by AngloGold Ashanti and other contracted companies but 2.07% of respondents were not aware of the employment of some community members. With regards to the number of people employed, ninety-two percent were not satisfied whiles eight percent of respondents were satisfied with the number of people employed from the communities. This was because very few people from the communities have been employed by AGA and other companies contracted by AGA. Hence communities have requested AGA to employ more people from the communities since most of the youth were unemployed. Therefore some of the youth from Dokyiwaa were hired by AGA to undertake construction works at the resettlement area for their community. Comparatively, the number of people employed by the contracted companies was more than those employed by AGA because according to respondents AGA had fired some employees in the communities and stopped employing people from the communities.

Results of the study indicate that most residents in the communities have had some level of education ranging from the primary level to the Senior High School level. It was also realised that the highest level of education reached by AGA miners and the contract workers interviewed was the SHS level. Therefore comparing the educational levels of AGA miners and the contract workers with the other residents, most residents have attained some level of education which makes them eligible to be employed by AGA. But most residents did not have skills that will enable AGA to offer them employment. According to Nyame and Grant (2007), skilled personnel are usually recruited from outside the area of mining operation in contrast to the unskilled labourers who tend to predominantly come from the area or region of operation itself.

To confirm the facts, the Community Relations Manager of AGA stressed that the company has awarded contracts to some companies who employ people from the communities but their employees are not recognised as AGA workers. Examples of some of these companies include Atlas Copco (Machinery/heavy duty spares), Rupco (Heavy duty hoses and spares), Sandvik, Metso, Hyspec, Ramoph and MBC – Mining and Building Company (Underground Mining).

4.9.2 Standard of Living of Employed Workers

Household surveys are the single most important source of data for making poverty comparisons and they are the only data source which can tell us directly about the distribution of living standards in a society, such as how many households do not attain some consumption level (Sahn and Younger, 2007). Assessing levels and trends in the well-being of members of a society is essential in order to describe the welfare of that society (ILO, 2003). From the survey, majority of respondents (57.03%) indicated that employees were not better-off with their standard of living in the communities' whiles 44.83% of respondents specified that employees were better-off. The reason why majority of employees were not better-off according to respondents was that people employed were mostly contract workers earning low monthly salaries.

Various reasons were given by respondents as to why the employees were better-off in the communities and according to Bawah (2001), measuring standard of living has historically been problematic because of the difficulty of defining an aggregate measure that captures the notion of well-being. Fifty percent of respondents attributed it to employees' ability to put up and acquire physical assets like buildings, motor bikes and cars. According to ILO (2003), ownership of assets is also an important variable in assessing a household's economic well-being, both in terms of the capacity of assets to generate income, economic security and power, which is useful for financing consumption expenditure. Twenty-five percent of respondents attributed it to good monthly salaries received by employees and 22.62% to the education of their wards to higher levels. The patronage of more items in the market was another reason by 2.38% of respondents (Figure 4.2). Expert Group on Poverty Statistics (2006) indicated that in the measurement of poverty, no consensus has been reached as to the most appropriate indicator to measure the level of living. But Stongman (2008) stated that the most direct and popular measures of living standards are income and consumption. According to ILO (2003), cash income, which in many countries forms the bulk of income, is less complex to measure and so can be observed reasonably accurately, frequently and relatively cheaply**.** In theory, the best indicator of welfare is the actual consumption of the individuals, and ideally this consumption would include both consumption of food and other goods as well as consumption of services such as education and health (Falkingham and Namazie, 2002).

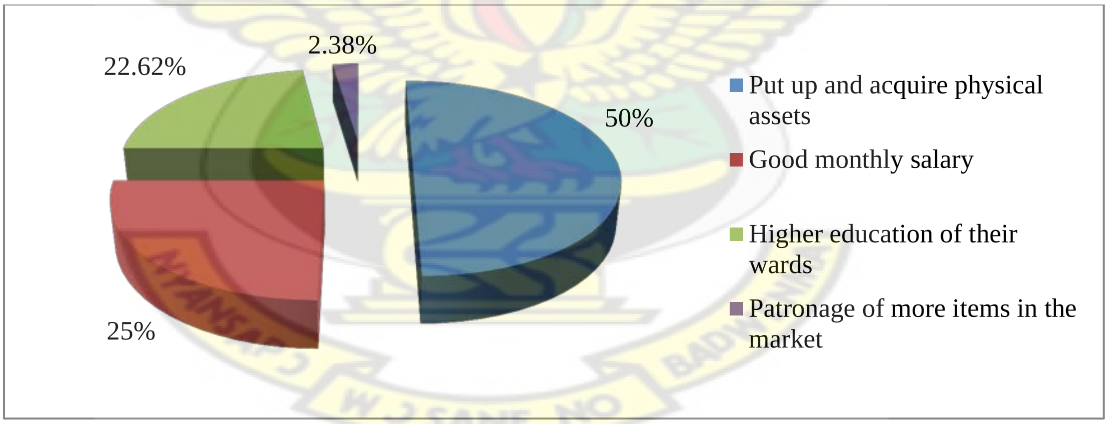

Figure 4.2: Reasons for the Higher Standard of Living of Employees

Furthermore, reasons why employees were perceived not to be better-off with their standard of living were given by respondents (Figure 4.3). The bulk of these respondents (68.04%) attributed it to the late payments of low monthly salaries and 13.40% to their inability to put up and acquire physical assets like houses and motor bikes. According to 8.25% of respondents, employees engage in other livelihood activities in order to support their families because of the low monthly salaries. Problems with higher education of wards and difficulty in catering for family members were the other reasons given by respondents.

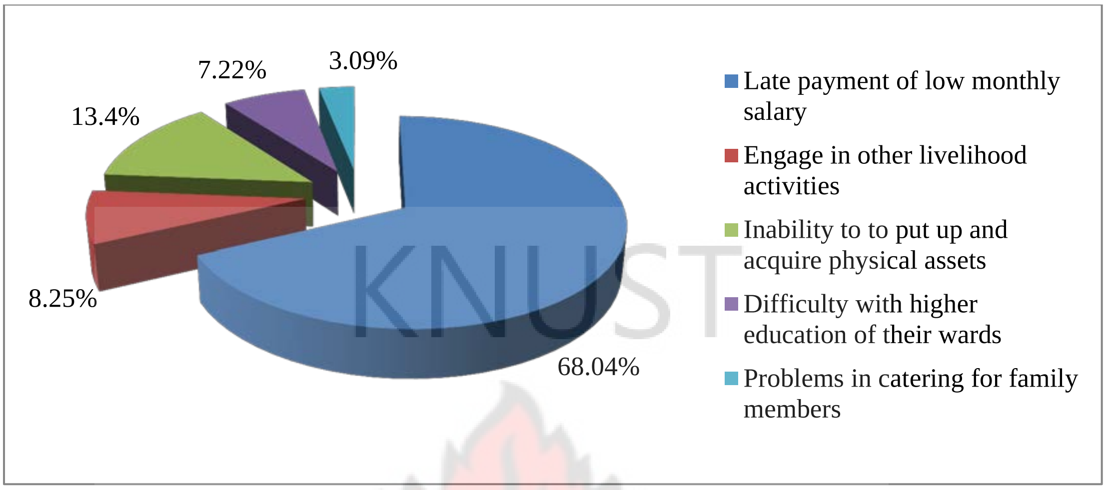

Figure 4.3: Reasons why Employees were not Better-off

Some of the contract workers sampled indicated that they received low monthly salaries ranging from GH¢ 70 to a maximum of GH¢ 90. The payment of the monthly salaries is also done very late which contributes to the hardship they face.

4.9.3 Presence of Illegal/ "Galamsey" Miners in Communities

Eighty-eight percent of respondents indicated that some community members engage in illegal mining as a livelihood activity whiles twelve percent thought otherwise (no illegal mining). According to Obara and Jenkins (2006), due to its labour intensity, small-scale mining may generate employment avenues, especially in remote rural areas where alternative job opportunities are scarce and low paying. But it has been profusely 'contaminated' with illegal artisanal or "galamsey" miners, their numerical strength and areas of operation of which remain largely unknown, although one estimate places the figure at approximately 100,000 to 200,000 (Nyame and Grant, 2007). The survey revealed that majority of the youth in the communities engage in illegal mining activities. People engaged in other livelihood activities like farming, carpentry etc occasionally indulge in illegal mining activities to boost their finances. According to Hinton (2006), seasonal artisanal and small scale mining provides a source of employment in agricultural off seasons and often generates capital for both agricultural and non-agricultural activities.

4.9.4 Standard of Living of Illegal Miners

Majority (71.72%) of respondents specified that their standard of living was low whiles 15.18% of respondents indicated they were better-off with their living standard in the communities. The remaining 13.10% of respondents were not sure of their living standard so could not provide subsequent related answers. Several reasons were given to justify why the illegal miners were better-off. Most respondents (56.52%) were of the opinion that illegal miners earned enough money from their activities especially during favourable seasons. According to DFID (2000), seasonality is expressed through seasonal shifts in prices, production, food availability, employment opportunities and health. Also their ability to acquire and put up physical assets like buildings, motor bikes and household assets etc. was the reason given by 34.78% of respondents while 8.7% of respondents indicated that they are able to cater well for their family members (Table 4.15).

Table 4.15: Reasons for the Higher Living Standards of Illegal Miners

Reason(s)	Number of Responses (n=23)	Percentage (%)
Acquire and put up physical assets	8	34.78
Cater well for family members	2	8.70
Earn enough money	13	56.52
Total	23	100

NOTE: Multiple responses

Reasons why illegal miners were not better-off were given by respondents as follows. The unavailability of a mining site for the illegal miners was the major reason given by 49.07% of respondents. According to respondents, AGA has employed the services of military men and private security to guard the tailings dam and other mining pits in the municipality, thereby restricting the illegal mining activities. Activities at the dam site were mostly carried out by scooping out the tailings in the dam and applying several methods in order to retrieve the gold. Low earnings and their inability to acquire and put up physical assets like buildings, motor bikes and household assets etc. were other reasons given by 41.6% and 4.63% of respondents respectively. The assets that a household possesses, or to which it has access, can be related to household income in that the latter may be conceptualised as returns to these assets. In this view a household's income reflects the assets it commands and the returns it is able to earn on these assets, which in turn depend on many factors (Hulme and McKay, 2005). Dependence on family members for daily source of food and problems in catering for family members were the other reasons given by 2.78% and 1.85% of respondents respectively (Table 4.16).

Table 4.16: Reasons why Illegal Miners were not Better-off with their Standard of Living

Reason(s)	Number of Responses (n=104)	Percentage (%)
Dependence on family members	3	2.78
Unavailability of a mining site	53	49.07
Low earnings	45	41.67
Problem in catering for family members	2	1.85
Inability to put up and acquire physical assets	5	4.63
Total	108	100

NOTE: Some respondents gave more than one answer (multiple responses)

4.9.5 Implementation of Alternative Livelihood Projects

Results from the survey indicated that no alternative livelihood projects had been implemented by AngloGold Ashanti in the sampled communities. It was established by some of the respondents that such projects were implemented years ago but not at the time of the study. According to Temeng and Abew (2009), mining companies are not willing to assume the traditional functions of government in providing general services to their areas of operation but these companies are increasingly pressured by growing international advocacy groups to minimise the negative impacts of mining activities on the environments and the local people. It was also recognised that, most of the youth in the communities were unemployed and some were looking forward to the implementation of alternative livelihood projects to equip them with the required skills to be engaged in livelihood activities of their choice. This will inevitably reduce the number of unemployed people in the communities and hence reduce illegal mining activities and peoples dependence on AGA for employment.

According to the Community Relations Manager, Sansu, Adaase, Diawuoso, Ahansoyewodea communities in the Obuasi Municipality were benefiting from the piggery projects and Adubriem, Hemang and Krodua in the Amansie Central District were also benefiting from aquaculture projects. Sansu was one of the sampled communities and contrary to what was said by the Community Relations Manager, respondents indicated that no projects had been implemented.

4.10 Contribution of Mining to Infrastructural Development

All communities sampled had benefited from infrastructural developments by AGA. Figure 4.4 shows the number of infrastructure provided for the communities. According to Jenkins and Obara (2006), mining has a huge impact on local communities; positive effects include the creation of new communities and wealth, income from export revenues and royalties, technology transfer, skilled employment and training for local populations and improvements in infrastructure such as roads, schools and health clinics. Boreholes and pipe-borne taps have been constructed in some communities to serve as their source of water. Five communities have been provided with boreholes namely; Sansu (9 boreholes), Apitikoko (2 boreholes), Dokyiwaa (3 boreholes), Binsere (2 boreholes) and Nhyiaeso (2 boreholes). Two other communities; Anyinam and Odumasi have also benefited from the development of pipe-borne taps (Plate 4.3).

With the provision of educational infrastructure, Anyinam, Sansu, Binsere and Odumasi have benefited from the construction of school buildings. Some respondents emphasized that the mining activities in Binsere and Odumasi damaged the communities' school buildings so AGA constructed new ones for the communities. Sansu and Anyinam have benefited from the provision of electricity poles and streets lights to provide the communities with electricity and light. According to community members, the communities are supplied with electricity free-of-charge.

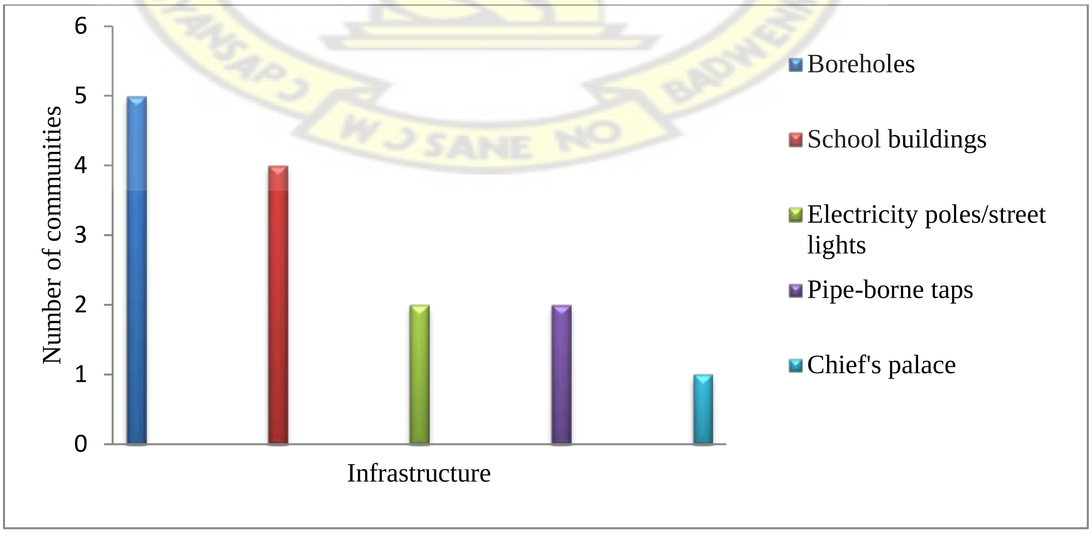

Figure 4.4: Infrastructure Provided for AGA Mining Communities

The construction of a chief's palace in Sansu by AGA was near completion although other opinion leaders in the community were not in favour of the construction of the palace. According to them, the chief alone benefits from certain provisions by AGA and therefore he has been reluctant to stand up against the negative effects of mining on the community.

Plate 4.3: Pipe-borne Tap Constructed at Odumasi.

Source: Field survey, April/May 2010.

4.11 Maintenance of Infrastructure

Infrastructure provided were satisfactorily maintained according to majority (91.97%) of respondents whiles 8.03% of the respondents were not satisfied with the maintenance of the infrastructure. Most of the respondents (54.01%) attributed the maintenance of the infrastructure to only AGA while 31.39% indicated that it was undertaken by only the communities (Table 4.17). The remaining respondents (11.68%) indicated that maintenance was undertaken by both AGA and communities with AGA undertaking the major maintenance activities whiles minor maintenance activities were done by the communities. Although government has also provided these communities with KVIP's, boreholes and schools, AGA does not undertake maintenance activities on the infrastructure provided by government.

Table 4.17: **Undertaking of Maintenance Activities of Infrastructure in AGA Mining Communities**

Maintenance Activities	Number of Responses (n=137)	Percentage (%)
AngloGold Ashanti Company	74	54.01
Community members	43	31.39
AGA and Community members	16	11.68
Not sure	4	2.92
Total	137	100

4.12 Conflicts and Neighbourhood Problems

4.12.1 Conflicts between Communities and AGA

Greater percentage of respondents (97.93%) revealed that there was no conflict between the communities and AGA whiles 2.07% of respondents thought otherwise.

Considering the relation between the communities and AGA, communities were in a cordial relationship with AGA according to 67.59% of respondents. This was followed by 21.28% of respondents who indicated that their relationship with AGA was intermediate and 11.03% stated that the relationship between them was bad (Table 4.18).

Table 4.18: Relationship Status of Mining Communities with AngloGold Ashanti

Relationship status	Number of Responses (n=145)	Percentage (%)
Cordial	98	67.59
Intermediate	31	21.38
Unfriendly	16	11.03
Total	145	100

4.12.2 Likelihood of Future Conflict Occurrence

The bulk of the respondents (42.07%) indicated there was the likelihood of future occurrence of conflict between the communities and AGA whiles 33.10% of respondents could not tell whether there could be any future conflict occurrence. The rest of the respondents (24.83%) were sure there would be no future conflicts with AGA.

Various reasons were given by respondents to justify why there was the likelihood of future conflict occurrence (Figure 4.5). AGA's refusal to employ the youth in the communities was the reason given by 36.92% of respondents and 25.38% attributed it to the company's refusal to fulfil the request of communities including the building of markets, clinics, community centres etc. According to Boon and Ababio (2009), immediately a new mining operation starts up, local communities often view it as an opportunity to be exploited, to be provided with resources and infrastructure that will enhance their welfare. Inadequate compensation payment was another major problem by 20% of the respondents. Some community members at Dokyiwaa indicated that due to the impending relocation of the community, some farmlands have been measured and inadequate compensation paid by AGA. The prevention of illegal mining activities by AGA and the degradation of community lands were the reasons by 13.85% and 10.77% of respondents respectively. According to Avci *et al*., (2009), on the resistance side, an important reason for the opposition of activities that deprive communities of access to natural resources and pollute the environment is local people's dependence on the environment 'as a source and requirement for livelihood', where livelihood is understood as a source of identity, and environment seen as constitutive of the community and its way of life. Respondents indicated that, the destruction of farmlands have resulted in the unemployment of some people who depended on agriculture for their livelihood.

The construction of smaller relocation buildings and the improper allocation of farmlands were the other problems by some sampled respondents. According to Owusu-Koranteng (2005), surface mining displaces many communities with grave consequences on livelihoods of communities and resettlement schemes of mining companies have led to the breakup of families through the reduction of rooms and construction of building types that do not preserve cohesion of our extended family system. The Community Relations Manager revealed that there was an impending northward extension of the tailings dam so the Dokyiwaa community will be resettled. Therefore the construction of resettlement buildings near Binsere has commenced and farmers whose farmlands will be affected have been provided with farmlands. But some farmers complained about the small sizes of the new farmlands and threats received from other people who were laying claims on those lands.

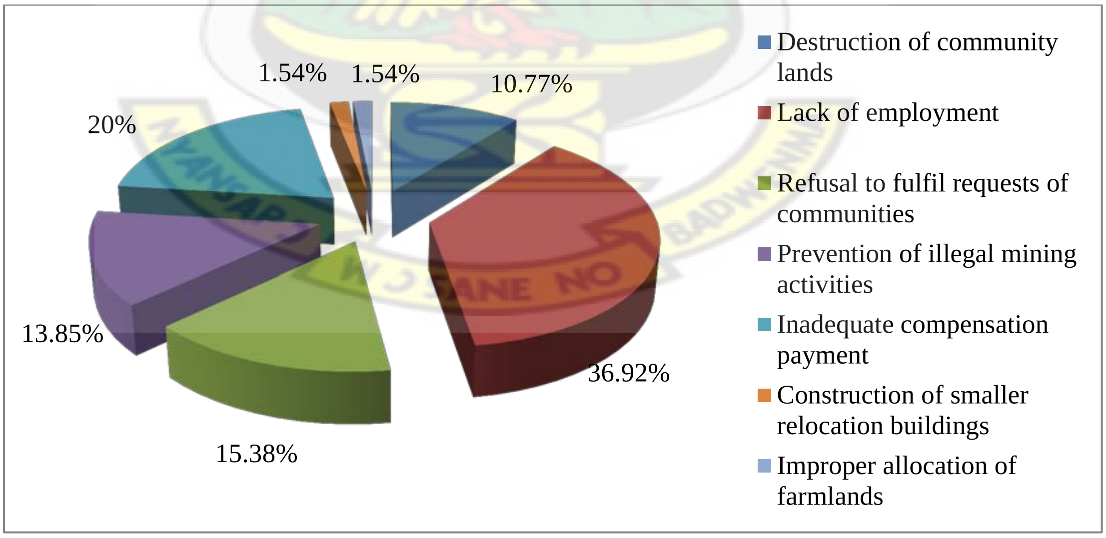

Figure 4.5: Factors Promoting the Likelihood of Future Conflict Occurrence in AGA Mining Communities

For respondents who were sure there will be no future conflict occurrence, 45.17% indicated that the communities were in good terms with AGA, because of the regular meetings held with them. Another reason by 31.43% of respondents was that, conflict will not be the best way of solving the problems while 8.57% attributed it to the construction of resettlement buildings for Dokyiwaa community (Figure 4.6). The payment of compensation (5.71%), the likelihood of being arrested (5.71%) and the employment of some community members (2.86%) were the other reasons given by respondents.

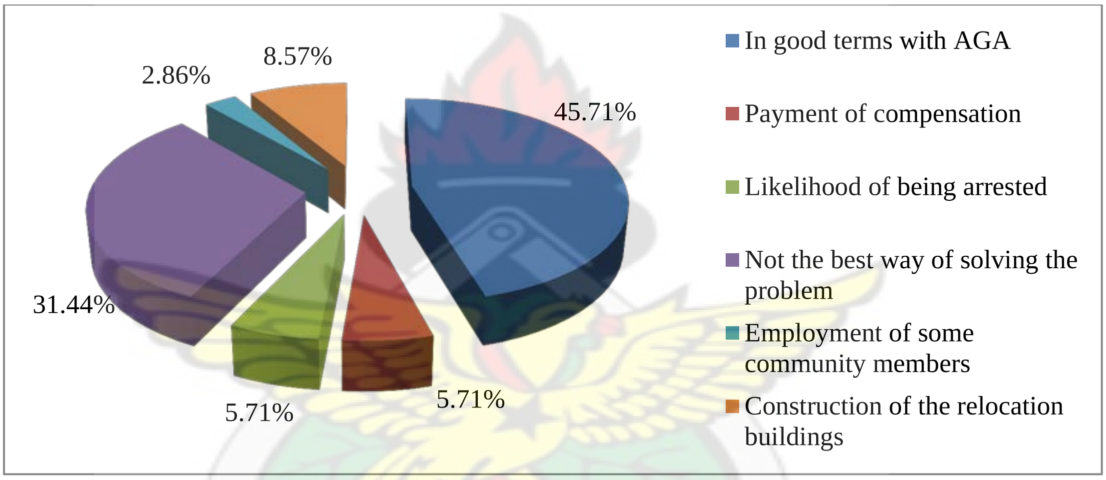

Figure 4.6: Reasons for the Non-Occurrence of Future Conflicts in AGA Mining Communities

4.12.3 Neighbourhood Problems

Majority (72.10%) of respondents indicated that communities were facing increasing neighbourhood problems whiles 27.90% of respondents were of the opinion that communities were not facing any neighbourhood problems from the mining activities.

Respondents who reported that there was an increase in neighbourhood problems in the communities gave reasons to justify their answer (Table 4.19). Majority (57.02%) of respondents indicated that high cost of living was the major neighbourhood problem. Respondents indicated that because of the destruction of some farmlands, people whose lands were destroyed have to spend money to purchase food stuffs they would not have bought if they were still farming. According to Akabzaa and Darimani (2001), there are several factors responsible for the high cost of living in mining communities; there is the disparity in incomes in favour staffs of mining companies and the mining industry has withdrawn a significant percentage of the labour force from agriculture and other income-generating activities by taking farmland away and holding out the false promise of employment. The fall in food production in some mining communities with relatively high population and high unemployment, accounts for high food price.

Stealing was another increasing neighbourhood problem according to 32.45% of respondents. Respondents indicated that most people have been rendered unemployed by the destruction of farmlands and the prevention of the youth from indulging in the illegal mining activities. This has lead to the stealing of farm produce and some properties of AGA forcing them to hire more security men to guide their properties.

Increasing drug usage in the communities especially among the illegal miners was another problem. According to 10.53% of respondents, the illegal mining activity is very tedious, so the youth mostly depend on drugs to undertake it.

Table 4.19: Increasing Neighbourhood Problems in AGA Mining Communities

Problems	Number of Responses (n=105)	Percentage (%)
High cost of living	65	57.02
Stealing	37	32.45
Drug addiction	12	10.53
Total	114	100

NOTE: Multiple responses

4.13 Contribution Towards Educational Assistance

4.13.1 Scholarship Opportunities for Communities

Majority (93.79%) of respondents were not aware of any scholarship opportunities put in place for students in the communities. From the survey it was realised that educational interventions for the development of human capital in the communities were not adequate. Dependents of AGA workers were the only people privileged to scholarship opportunities at the tertiary level of education while other community members had no such opportunities.

4.13.2 Informal Education for Communities

It can be deduced from the response of majority (99.31%) of respondents that AGA had not organized any informal education for illiterate members of the communities. The Community Relations Manager of AGA indicated that although such a programme has not been implemented, AGA supports or donates towards the Community Literacy Programme and AGA hopes that with the implementation of the Community Trust Fund, such educational support on a large scale will be considered. Amonoo (2006), stated that investment in human resource development begins with education, which does not only broaden one's perspective on global and national issues, but also opens up access to greater opportunities for improvement in one's living conditions. According to Boon and Ababio (2009), most mining companies have concentrated their Corporate Social Responsibility interventions in the areas of education, health, alternative livelihood income generating activities. But results obtained indicated that, there are very little Corporate Social Responsibility interventions in the area of education.

4.14 Impacts of Mining on Sources of Water

4.14.1 Problems with Sources of Water

Majority (65.52%) of respondents had problems with the availability and quality of their sources of water whiles 34.48% had no problems with their water source. Discoloured/dirty water was the major problem faced by the communities (Plate 4.4). This problem was associated with water produced from some boreholes and taps in some of the communities. The Dokyiwaa community attributed this problem to their old and rusty water storage tank in the community. Also 12.17% of respondents reported that water produced from some of the boreholes contained oil droplets, making drinking very difficult. Infrequent flow of pipe-borne water (5.22%) was another problem faced by Anyinam and Dokyiwaa communities. Other problems faced by some communities were the unpleasant/salty taste, elemental pollution and unpleasant odour of water produced from the boreholes (Table 4.20).

Plate 4.4: Sample of Pipe-borne Water Fetched at Dokyiwaa.

Source: Field survey, April/May 2010

According to Owusu-Koranteng (2008), from the environmental standpoint, water should be available in potable form for the entire population with minimal effort, and that its availability on a sustained basis should be guaranteed. The availability of potable water to the population is an indicator of social and economic well being.

According to the Assemblyman of Sansu, Standard Boards measured the iron levels of their boreholes and results indicated that it was above the standard level. Owusu-Koranteng (2008) indicated that hydro chemical analytical results of water bodies in Obuasi showed that streams in the study area are more polluted than groundwater with the groundwater iron and arsenic values exceeding the maximum permissible World Health Organization (WHO) guide values in some of the samples.

Table 4.20: Problems with Domestic Sources of Water in AGA Mining Communities

Problems	Number of Responses	Percentage (%)
Dirty/discoloured water	87	75.65
Unpleasant odour/scent	1	0.87
Unpleasant/salty taste	5	4.35
Contains oil droplets	14	12.17
Elemental pollution	2	1.74
Infrequent flow	6	5.22
Total	115	100

NOTE: Multiple responses

Majority (68.45%) of respondents indicated that their community have informed AGA about the problems associated with their source of water while 31.58% were not aware of any actions taken by their communities. Taking into consideration the reaction of AGA, 96.84% of respondents indicated that AGA has done nothing to help rectify the problems affecting the quality of domestic sources of water for the communities. Contrary to the response of the majority, 3.16% indicated that AGA had taken water samples from their community for subsequent actions.

4.14.2 Impact of Mining on Water Bodies

Residents of sampled communities did not utilize available water bodies for their domestic purposes due to several reasons (Figure 4.7). Most of the communities had more than one water bodies but were not utilized by residents because of the alleged pollution of these water bodies by mining activities. According to Owusu-Koranteng (2008), water pollution occurs when a body of water is adversely affected due to the addition of large amounts of materials to the water and is also considered polluted when it is unfit for its intended use. Major rivers located in the communities included Nyam, Ntonsua, Apitikoko, Saah, Dokyiwaa, Kwame Tawia, Akapoli and Kao etc. According to respondents, these rivers have been impacted negatively by the mining activities in and around the communities thereby affecting their quality. Respondents indicated that alternative sources of water were constructed by AGA for the various communities because of the negative impacts of their activities on the river bodies.

Majority (76.12%) of respondents indicated that mining activities have caused chemical pollution of rivers in the communities. According to respondents, this problem originated from polluted waste water pumped from mine pits and the discharge of tailings into the rivers. The other negative impacts of mining on rivers were the drying up and siltation/sedimentation of some rivers which were reported by 11.94% and 11.94% of respondents respectively (Figure 4.7). According to Owusu-Koranteng (2005), the proliferation of surface mining companies has resulted in stream pollution resulting from cyanide spillages, acid mine drainage, tailings leakages, mine waste disposals, and mine pits. These have tended to deprive communities of access to water, which is a basic need for human survival. Illegal miners in the communities have therefore taken advantage of the situation to undertake their gold mining activities in some of these rivers since according to them the rivers have already been polluted by AGA. These illegal miners revealed that tailings and the waste water pumped from mine pits into the rivers contain very small particles of gold.

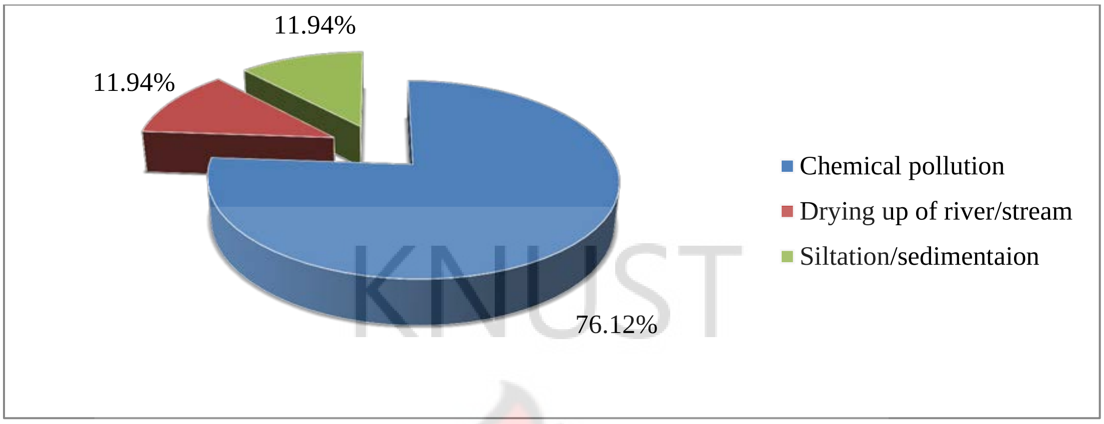

Figure 4.7: Negative Effects of Mining on Water Bodies in AGA Mining Communities

It was alleged that some river channels have been diverted by AGA and this has resulted in the drying up of these rivers. According to residents of Sansu, river Saah which happens to be the only river in the community has almost dried up because of the diversion of the river by AGA (Plate 4.5).

Plate 4.5: Illegal Mining Activities in an Almost Dried up River Saah in Sansu

Source: Field survey, April/May, 2010

Respondents also indicated that the sedimentation was caused by the discharge of tailings and waste water from mine pits into the rivers. Because of the state of the rivers, residents were depending mostly on alternative sources of water in the communities such as boreholes, pipe water and hand-dug wells.

CHAPTER FIVE

CONCLUSION AND RECOMMENDATIONS

5.1 Conclusion

The work has presented and critically examined the impacts of mining on the land use systems and livelihoods in the Obuasi Municipality.

Results of the study have shown that agriculture is the major livelihood activity for the communities. Farmers in the communities practiced cocoa, oil palm, citrus and food crops farming systems. Majority of farmers were into the tree crops farming system compared to the food crops because of the relative profitability of the former. Under each of these farming systems, farmers either practiced mixed cropping or mono cropping systems but it was identified that more farmers practiced the mixed cropping system compared to the mono cropping system. Most of the farming systems were in small holdings, which were limited in size (less than 3 hectares) and relied on family labour.

Mining activities had several negative externalities on the farming systems which in one way or the other affected the productivity of some of the farming systems. Most farmers depended on rain-fed agriculture; therefore their source of water for farming was not polluted by the mining activities. Few farmers who were dependent on available water bodies in the communities for farming mainly used them for the spraying of cocoa farms. Problems noticed by farmers from the use of the water bodies were low yields of crops, stunted growth of crops, rotting, yellowing and dying of crops before maturity.

It was clear that most farmers did not encounter any difficulties with their ability to access their farms and transport farm produce with the exception of a few farmers who had various problems. Problems faced by farmers were water logged and eroded routes to farmlands, blocked footpath by AGA and the excavation of pits by illegal miners on some routes. However these problems did not prevent farmers from accessing their farmlands but only made the accessibility and transport of farm produce very challenging.

With regards to the effects of mining on crop production and productivity, most farmers in the communities were victims of the negative externalities. The reduction of the average annual yields of farmers was almost entirely attributed to the presence of mining activities in the communities. Farmers' crop production and productivity constraints were the destruction of farmlands, air pollution, land degradation, pollution from tailings dam, flooding of farmlands and farmlands taken over by AGA. Under these circumstances, the cost of production of most farmers has been very high which have resulted in the reduction of annual yields at the end of the farming season.

Positive externalities of mining have an enormous potential to contribute to national and local development. In the light of this, some members of the communities have been employed by AGA and companies contracted by AGA, though community members were not satisfied with the number of people employed. With regards to the standard of living, it was perceived by majority of respondents that the bulk of employees were not better-off than the rest of the community members. Most employees in the communities were contract workers employed by contracted companies with a few of them being AGA workers. It was also revealed that because of the high unemployment rate in the communities, most of the youth engaged in illegal mining activities. The perception of majority of respondents was that people who engaged in the illegal mining activities obtained very little benefits because of their low earnings. Key among the reasons given was the unavailability of a mining site because of the employment of private security and military men who guard the tailings dam and mine pits where their activities mostly took place. Results of the survey revealed that AGA had refused to implement any alternative livelihood projects for communities to create employment in the communities. Some community members were looking forward to the implementation of such projects whiles others were not in favour and instead wanted AGA to employ them. AGA however insisted that communities like Sansu, Adaase, Diawuoso and Ahansoyewodea had benefited from piggery projects but from my visit to Sansu, nothing of that sort was observed in the community.

Regarding the contribution of mining to infrastructural development and maintenance, it was revealed that AGA has constructed boreholes, school buildings, electricity poles, chief's palace and pipe-borne taps for the sampled communities. The construction of some of the infrastructure was as a result of the negative impacts of mining on the livelihoods of the communities. Aside the infrastructure provided, communities have requested for the provision of other infrastructure to enhance the development of the communities. Most community members were satisfied with the maintenance of the infrastructure provided. Maintenance was undertaken by either AGA or communities depending on the cost of maintenance. Minor maintenance was undertaken by communities whiles major maintenance activities were undertaken by AGA. Although majority of respondents were satisfied with the maintenance, it was observed that some boreholes and pipe-borne taps in some communities were dysfunctional.

Despite the non-existence of conflicts, certain events could serve as sources of contention between communities and AGA. Key among the reasons given was the lack of employment of community members. Other factors were the destruction of community lands, prevention of illegal mining activities, inadequate compensation payment, AGA's refusal to fulfil requests of communities and the construction of smaller relocation buildings. Aside these problems, some communities were also facing increasing neighbourhood problems as a result of the mining activities. Mining activities by both AGA and illegal miners were the underlying causes of stealing, drug addiction and high cost of living, which were the neighbourhood problems, faced by communities.

Educational interventions for the development of human capital in the communities were not adequate. Dependents of AGA workers were the only people privileged to scholarship opportunities at the tertiary level of education while other community members had no such opportunities. Likewise educational opportunities for illiterate members were non-existent but AGA was considering such educational support on a large scale should the Community Trust Fund be implemented.

Due to the negative externalities of mining on water bodies that served as sources of water for communities, AGA has provided boreholes and pipe-borne water as alternative sources of water for communities. Communities were unable to utilize available water bodies because of the chemical pollution, drying-up and siltation/sedimentation caused by mining activities. Most communities had problems with the quality of water received from sources constructed by AGA. Communities expected AGA to rectify these problems but according to them, no action had been taken to remedy the situation. AGA was therefore perceived as being insensitive to the plight of communities due to their inactions.

5.2 Recommendations

Based on the conclusion of the study, recommendations are necessary to improve livelihoods and relations between communities and AGA.

Farmers in the various communities should form vibrant farming groups/associations to help maximize the interests of its members. It was revealed that opinion leaders in the communities usually negotiate with AGA on behalf of farmers when the company wants to take actions that will affects farmers in the communities. Such negotiations should have been held with leaders of farming groups to know exactly their concerns and interests since most at times, farmers are not satisfied with the decisions taken by AGA. Such direct negotiations will increase the confidence of farmers in the mining company. Such groups can advice its members on the consequences of their actions on the company's operation such as farming at unapproved places and the effects of indulging in speculative farming. Such groups can be more effective in securing the rights of its members to improve their livelihoods.

Farmers also indicated that AGA did not assist them in order to improve the productivity of their farming systems but were only recipients of the negative externalities of mining. Therefore one area where AGA can assist farmers is by helping to provide extension services for these farmers. Farmers will be educated on ways of improving their current methods of farming to maximise profits at the end of the farming season. Also based on the environmental conditions in the communities, specific methods of farming can be extended to the local farmers to improve their yields.

To reduce the extent of farmland destruction, AGA should inform communities of its operational plans in the various communities. This will inform communities about the periods when certain areas of their communities will be exploited. This will enable farmers to fully concentrate on their farming activities and adequately invest in their farms to increase productivity. This is because, some farmers were uncertain about the time they could lose their farmlands to AGA because some nearby farmlands had been compensated for and taken over by AGA. Because of this, investing considerably in the farming systems was considered to be risky since inadequate compensation will be paid for losing land. AGA should also educate communities about the proper siting of farmlands in the communities. This is because some farmlands were located too close to the tailings dam which can easily affect the productivity of these farms in several ways.

Results indicated that unemployment rate in the communities was quite high and most of the unemployed were looking forward to being employed by AGA. It is recommended that if AGA and other contracted companies cannot employ more local people from the communities, effective alternative livelihood projects should be implemented for the various communities. In that case, most unskilled persons in the communities will be trained to be skilled workers, thereby reducing their dependence on the company for employment. Illegal mining activities can also be reduced because most of the youth engaged in it are either unemployed or engage in less profitable livelihood activities. The implementation of such projects will provide them with skills and reduce their dependence on the illegal mining activities. There should be proper consultation with the communities before such projects are implemented in order to meet the specific needs of the communities.

Sources of water constructed for the communities have been beneficial to residents but have their own attendant problems. The quality of water received by some communities was very bad and this can create health problems for these communities. Therefore AGA should regularly take samples of water from the communities to determine their quality. The size of the storage tank at Odumasi was too small for the community and had started rusting as a result of its long period of use. Several requests had been made to AGA to replace the tank which affects the quality of water received but to no avail. AGA should therefore help replace the tank for the benefit of the community.

According to community members, mining activities have created several unresolved problems for the communities and requests by communities are yet to be fulfilled by AGA. The major sources of contention were the destruction of community lands, lack of employment, prevention of illegal mining activities, inadequate compensation payment, construction of smaller relocation buildings and refusal to fulfil the requests of communities. According to them, there is the likelihood of a conflict with AGA as a way of displaying their displeasure. Contrary to this, most opinion leaders interviewed did not envisage any future conflict with AGA. Therefore aside having meetings with leaders of the communities, AGA should link up well with the other members of the communities to be fully aware of their problems and intentions. By becoming fully aware of all their problems and intentions, steps can be taken to address their realistic and unrealistic expectations and to inform them of the commitments of the company in order to curb future conflict occurrence. A responsible company should operate to reflect the values, needs and expectations of impacted communities. This will therefore auger well for a positive and fruitful relation between the company and the communities.

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APPENDICES

APPENDIX 1

QUESTIONNAIRE ON THE IMPACT OF MINING ON LAND USE SYSTEMS

INSTITUTION: Kwame Nkrumah University of Science and Technology

TOPIC: Assessment of the impact of mining on the land use systems and livelihoods in the Obuasi municipality.

COURSE: MSc Environmental Resources Management

Community: ....

BACKGROUND DATA

1. Name: ....
2. Gender: a. Male [ ] b. Female [ ]
3. Age: ....
4. Educational level attained
   a. Illiterate [ ] b. Tertiary [ ] c. Senior High School/Vocational [ ]
   c. Junior High School/Middle [ ] d. Basic School [ ] e. Non-formal [ ]
   f. Other (specify): ....
5. Apart from farming, do you have any other source(s) of income?
   a. Yes [ ] b. No [ ]
6. If yes, what other livelihood activities are you engaged in?
   ....
7. Are you the breadwinner of your family? a. Yes [ ] b. No [ ]
8. If yes, how many people are currently depending on you? ....
9. How long have you been staying in this community? ....
10. Are you a native of this community? a. Yes [ ] b. No [ ]
11. If no, where do you come from? ....

IMPACT OF MINING ON THE LAND USE SYSTEMS

1. How long have you been farming in this community?
   ....
2. What farming system(s) are you currently practicing and the area of land covered by each system?

Farming system(s)	Area of land
....	....
....	....
....	....
....	....
....	....
....	....
....	....

3. Have you been practicing only this type of farming system(s) since you started farming years ago? a. Yes [ ] b. No [ ]
4. Give reason(s) for your chosen option?
   ....
   ....
   ....
5. What is the terrain of the farmland?
   a. Flat [ ] b. Sloping [ ]
6. Did surface mining in this community commence before you started your farming activities years ago? a. Yes [ ] b. No [ ]
7. Are you satisfied with your current level of crop yields?
   a. Yes [ ] b. No [ ]

APPENDIX 1 (Cont'd)

8. If no, have your crop yields been decreasing/ reducing with time?
   a. Yes [ ] b. No [ ]
9. Can you estimate your current and previous annual average crop yields? (Previous annual average yields represent average yields before reduction in yield was detected).

Previous annual crop yields	Recent annual crop yields
....	....
....	....
....	....

10. Can you attribute this situation to mining activities in this community?
    a. Yes [ ] b. No [ ]
11. If yes, how do the mining activities cause the yield reduction?
    ....
    ....
    ....
12. If no, what is responsible for yield reduction apart from the mining activities?
    ....
    ....
13. What is your main source of water for farming?
    a. Stream/river [ ] b. Well [ ] c. Rainfall [ ] d. Other (specify) ....
14. Has mining posed any problems to the availability and quality of the source of water?
    a. Yes [ ] b. No [ ]
15. If yes, what specific problems have been caused by the mining activities?
    ....
    ....
16. How has this problem affected your crop yields?
    ....
    ....
    ....
17. Have you lost your farm land before? a. Yes [ ] b. No [ ]
18. If yes, how many times? ....
19. Have you received any compensation from AngloGold Ashanti Company?
    a. Yes [ ] b. No [ ]
20. If yes, for what reason were you compensated?
    ....
    ....
21. Did the compensation correspond to what was lost?
    a. Yes [ ] b. No [ ]
22. Has there been any destruction to your farm that went without compensation?
    a. Yes [ ] b. No [ ]
23. If yes, who was responsible for this destruction?
    a. Illegal miners [ ] b. AngloGold Ashanti Company [ ]
    c. Other (specify)...
24. Do you harbour any fears that you can lose your farmland at any moment?
    a. Yes [ ] b. No [ ]
25. Has mining withdrawn people from farming in this community?
    a. Yes [ ] b. No [ ]
26. If you were offered employment with the mines, will you accept the offer at the expense of your farming? a. Yes [ ] b. No [ ]
27. Give reason(s) for your chosen option?
    ....
    ....
28. Does mining activities pose any difficulties to your ability to access your farm and transport your farm produce from the farm?
    a. Yes [ ] b. No [ ]
29. If yes, what specific difficulties do you face?
    ....
    ....

APPENDIX 1 (Cont'd)

30. Have AGA's been assisting farmers in the community to improve your farming system?
A. Yes [ ]   b. No [ ]

31. If yes, what kind of assistance have you received?
....
....

APPENDIX 2

QUESTIONNAIRE ON IMPACT OF MINING ON LIVELIHOODS

THESIS TOPIC: Assessment of the impact of mining on the land use systems and livelihoods in the Obuasi municipality.

INSTITUTION: Kwame Nkrumah University of Science and Technology

COURSE: MSc Environmental Resources Management
(This study is for academic purposes and any information provided will be treated confidentially).

Community...

Background data

1. Name: ....
2. Gender a. Male [ ] b. Female [ ]
3. Age: ....
4. Educational level attained.
   a. Illiterate [ ] b. Tertiary [ ] b. Senior High School/Vocational [ ]

   c. Junior High School/Middle [ ] d. Basic school [ ] e. Non-formal [ ]

   f. Others (specify)..
5. Occupation(s):
   ....
6. Marital status
   a. Single [ ] b. Married [ ] c. Divorced [ ] d. Widowed [ ]
7. Are you the bread winner of your family? a. Yes [ ] b. No [ ]
8. If yes, how many people are currently depending on you?
   ....
9. How long have you been staying in this community?
   ....
10. Are you a native of this community?
    a. Yes [ ] b. No [ ]

11. If no, where do you come from? ....

EFFECTS OF MINING ON EMPLOYMENT AND INCOME GENERATION

1. In your opinion, have mining activities benefited people of this community in terms of employment creation and income generation? a. Yes [ ] b. No [ ]
2. Are you aware of people in this community who are engaged in mining activities?
   a. Yes [ ] b. No [ ]

3. Have AngloGold Ashanti or any contracted company employed some people from this community? a. Yes [ ] b. No [ ]
4. What specific types of work are they employed to undertake (casual/permanent)?
   ....
5. Are you satisfied with the number of people employed from this community?
   a. Yes [ ] b. No [ ]
6. Are these employed workers better off (in terms of their standard of living) in the community?
   a. Yes [ ] b. No [ ]
7. Give reasons for the chosen answer in question 4.
   ....
   ....
   ....

8. Apart from those employed by the company, are other people also involved in illegal or “galamsey” mining operations? a. Yes [ ] b. No [ ]

APPENDIX 2 (Contd.)

9. Are these “galamsey” operators better off (in terms of their standard of living) in the community? a. Yes [ ] b. No [ ]
10. Give reason(s) for your chosen answer in question 9.
....
....
....
11. Are also you willing to engage in “galamsey” operations when the opportunity arises?
a. Yes [ ] b. No [ ]
12. Give reason(s) for your answer in question 11.
....
....
13. Has the company implemented any alternative livelihood programmes in this community?
a. Yes [ ] b. No [ ]
14. If yes, what are the types of alternative livelihood programmes?
....
....
15. Are you a beneficiary? a. Yes [ ] b. No [ ]
16. Are you aware of any problems associated with the programmes?
....
....
17. Are you aware of people who have lost their livelihood activities because of mining in this community? a. Yes [ ] b. No [ ]
18. What were the reasons why they lost their livelihood activities?
....
....
....

CONTRIBUTION OF MINING TO INFRASTRUCTURAL DEVELOPMENT

1. Have there been any infrastructural developments by AngloGold Ashanti Company in this community? a. Yes [ ] b. No [ ]
2. If yes, what infrastructure have been provided for the community?
....
....
3. Which other infrastructure(s) do you wish had been provided to the community by the AGA Company?
....
....
....
4. Are all the infrastructure being used for their intended purposes?
a. Yes [ ] b. No [ ]
5. If no, which infrastructure is/are not being used for their intended purposes and what are they being used for currently?
....
....
6. What are the reasons behind the current uses other than what they were meant for?
....
....
7. Are the infrastructure satisfactorily maintained? a. Yes [ ] b. No [ ]
8. If yes, who has been responsible for their maintenance?
....
9. Are all the infrastructure still in use? a. Yes [ ] b. No [ ]
10. If no, what are the reasons?
....
....
....

APPENDIX 2 (Contd.)

NEIGHBORHOOD PROBLEMS AND CONFLICTS

1. Is there any conflict between the community and the AngloGold Ashanti Company?
 a. Yes [ ] b. No [ ]
2. If yes, what brought about the conflict?
 ....
 ....
3. Is there any conflict between the community and illegal or "galamsey" miners in this community? a. Yes [ ] b. No [ ]
4. If yes, what brought about the conflict?
 ....
 ....
5. Has the conflict lead to the destruction of any property in the community?
 a. Yes [ ] b. No [ ]
6. Has the conflict been settled/ managed? a. Yes [ ] b. No [ ]
7. If no how long has the conflict been pending?
 ....
8. Have there been previous conflicts between the community and the miners?
 a. Yes [ ] b. No [ ]
9. **i.** How was the conflict settled or managed?
 a. Not sure [ ] b. Negotiation [ ] c. Mediation [ ] d. Litigation [ ]
 e. Arbitration [ ] e. Other (specify)
 ....
 ii. How was it done?
 ....
 ....
10. What is the current relationship between the community and the miners?
 a. Cordial [ ] b. Intermediate [ ] c. Unfriendly [ ]
11. Judging from the present situation, is there the likelihood of any future occurrence of conflict? a. Not sure [ ] b. Yes [ ] c. No [ ]
12. If yes/no, give reasons?
 ....
 ....
 ....
13. Apart from conflict, has there been an increase in neighbourhood or social problems with the presence of the mine? a. Yes [ ] b. No [ ]
14. If yes, what neighbourhood problems is the community facing as a result of the mining activities?
 ....
 ....

EDUCATIONAL ASSISTANCE

1. Does the community have a school?
 a. Yes [ ] b. No [ ]
2. Are you aware of any scholarship opportunity put in place by the company for the brilliant but needy students? a. Yes [ ] b. No [ ]
3. Has the company being organizing any informal education for illiterate members of this community? a. Yes [ ] b. No [ ]
4. If yes, how would you rate patronage by these members of the community?
 a. High [ ] b. Average [ ] c. Poor [ ]

EFFECT ON RESOURCES

1. Which of the following sources of water do members of this community use for domestic purposes?
 a. Pipe borne [ ] b. Borehole [ ] c. Hand dug well [ ] d. Stream/river [ ]
 e. Other (specify)...
2. Does the community have problems with the availability and quality of the source of water?
 a. Yes [ ] b. No [ ]

APPENDIX 2 (Contd.)

3. If yes, what specific problems are you facing?
....
....
4. Can these problems be attributed to the mining activities in this community?
a. Yes [ ] b. No [ ] c. Not sure [ ]
5. If no, what is causing these problems?
....
....
6. What has the community done about this problem?
....
....
....
7. What was the reaction of the culprits?
....
....
8. **i.** Which other form of pollution does the community face from the mining activities?
a. Air pollution [ ] b. Sound Pollution [ ] c. Vibration [ ]
d. others (specify) ....

ii. Give reasons?
....
....
....
9. Is there a river in this community? a. Yes [ ] b. No [ ]
10. If yes, how many rivers/streams are in this community?
....
11. Can you give the name(s) of the rivers/streams in this community?
....
....
12. Has mining activities in this community polluted the rivers/streams?
a. Yes [ ] b. No [ ]
13. What specific problems have been caused?
....
....
....

APPENDIX 3

QUESTIONNAIRE FOR THE COMMUNITY RELATIONS MANAGER, ANGLOGOLD ASHANTI, OBUASI

INSTITUTION: KWAME NKRUMAH UNIVERSITY OF SCIENCE AND TECHNOLOGY.

THESIS TOPIC: ASSESSMENT OF THE IMPACT OF MINING ON THE LAND USE SYSTEMS AND LIVELIHOODS IN THE OBUASI MUNICIPALITY.

COURSE: MSc ENVIRONMENTAL RESOURCES MANAGEMENT

BACKGROUND DATA

1. NAME: ....

IMPACT OF MINING ON LAND USE SYSTEMS AND LIVELIHOODS

1. Are farmlands located on your concession lands in the various communities?
   a. Yes [ ]   b. No [ ]
2. Do you pay any compensation for farmers whose farmlands are destroyed through our mining activities?
   a. Yes [ ]   b. No [ ]
3. Why have the farmers been allowed to still farm on your concession lands since you pay them compensations when their farmlands are destroyed by the mining activities?
   ....
   ....
   ....
4. From the feedback you receive, are all the farmers mostly satisfied with the compensation they receive?
   a. Yes [ ]   b. No [ ]   c. Not all [ ]
5. How is the compensation arrived at/calculated for the farmers?
   ....
   ....
   ....
6. Do some people indulge in speculative farming or farming at places with the intention of receiving compensation with the foreknowledge that those areas will be destroyed?
   a. Yes [ ]   b. No [ ]
7. How do you deal with such people?
   ....
   ....
   ....
8. Have your outfit been receiving complaints from the communities about their sources of water constructed for them by the AGA?
   a. Yes [ ]   b. No [ ]
9. If yes, what actions are being undertaken to help rectify their problems?
   ....
   ....
   ....
10. Are there plans to relocate the Dokyiwaa community?
    a. Yes [ ]   b. No [ ]
11. If yes, what are the reasons behind the planned relocation of the community?
    ....
    ....
    ....
12. Are there any plans to provide farmlands to farmers who will lose their farmlands because of the relocation?   a. Yes [ ]   b. No [ ]
13. Will the size of an allocated farmland correspond to the size of the farmland lost?
    a. Yes [ ]   b. No [ ]

APPENDIX 3 (Contd.)

14. If no, how will the size of a farmland be calculated for each farmer?
....
....
....

15. Have AGA awarded contracts to companies who have employed some people from the various communities as contract workers?
a. Yes [ ] b. No [ ]

16. If yes, what are the names of the companies awarded with the contracts?
....
....
....

17. Currently, has AngloGold Ashanti implemented any alternative livelihood programmes in any of the communities in the Obuasi Municipality?
a. Yes [ ] b. No [ ]

18. If yes, which communities are currently benefiting from these implemented programmes?
....
....
....

19. If no, what challenges are preventing AGA from implementing such programmes?
....
....
....

20. In which year did AngloGold Ashanti commence with surface mining in the Obuasi Municipality?
....

21. When did it commence in the following communities?
Dokyiwaa .... Sansu ....
Apitikoko .... Nhyieso ....
Anyinam .... Binsere ....
Odumasi ....

APPENDIX 4

CROPS COMPONENTS OF THE VARIOUS FARMING SYSTEMS

Cocoa Farming System

Crops mixed with Cocoa	Number of farmlands with crop	Percentage (%)
Plantain	30	39.47
Cassava	22	28.95
Cocoyam	12	15.79
Pineapple	3	3.94
Maize	3	3.94
Sugar cane	2	2.63
Oil palm	1	1.32
Yam	1	1.32
Water yam	1	1.32
Orange	1	1.32
Total	76	100

Note: Multiple responses

Oil Palm Farming System

Crops mixed with oil palm	Number of farmlands with crop	Percentage (%)
Cocoa	3	13.64
Cassava	9	40.9
Plantain	6	27.27
Pineapple	2	9.09
Orange	1	4.55
Cocoyam	1	4.55
Total	22	100

Note: Multiple responses

Citrus Farming System

Crops mixed with citrus	Number of farmlands with crop	Percentage (%)
Oil palm	1	33.33
Cassava	1	33.33
Pineapple	1	33.33
Total	3	100

APPENDIX 4 (Contd.)

Food Crop Farming System

Mono Cropping System

Food Crops	Number of farmlands with crop	Percentage (%)
Cassava	2	50
Yam	1	25
Okro	1	25
Total	4	100

Mixed Cropping System

Food Crops	Number of farmlands with crop	Percentage (%)
Plantain	25	30.86
Cassava	25	30.86
Cocoyam	16	19.75
Maize	8	9.90
Yam	3	3.70
Pineapple	2	2.47
Water yam	1	1.23
Pepper	1	1.23
Total	81	100

Note: Multiple responses

APPENDIX 5

ESTIMATION OF THE AVERAGE ANNUAL YIELDS OF COCOA AND CITRUS FARMING SYSTEMS

Cocoa Farming System – Yield per Hectare

Area of Land (hectares)	Previous Annual yield (Kg/ha)	Recent Annual yield (Kg/ha)	Age of Cocoa Stand (years)
1.21	284.09	180.79	27
2.02	170.17	139.23	45
1.21	516.53	129.13	27
0.61	256.15	0	7
0.81	347.22	154.32	4
1.82	343.41	154.53	15
4.86	154.32	57.87	25
2.02	108.29	46.41	20
1.01	123.76	30.94	9
0.61	204.92	153.69	7
1.82	85.85	51.51	12
1.62	270.06	19.29	21
0.81	115.74	38.58	25
2.02	77.35	15.47	29
3.84	105.79	56.97	35
1.21	154.96	77.48	30
1.42	132.04	132.04	12
8.09	77.26	77.26	20
4.05	115.74	69.44	30
4.86	231.48	70.73	41
2.83	121.47	77.3	29
13.35	128.75	70.22	40
12.55	74.7	39.84	24
3.04	102.8	51.4	25
4.05	84.88	54.01	19
2.02	123.76	46.41	35
0.4	168.75	78.13	8
2.83	143.55	77.3	30
1.01	371.29	154.7	20
1.21	232.44	25.83	25
1.21	206.61	77.48	19
0.2	312.5	156.25	23
0.4	39.06	78.13	7
1.62	231.48	115.74	30
0.4	195.31	117.19	6
2.02	123.76	46.41	30
1.62	385.8	385.8	15

1.21	645.66	103.31	40	
1.82	515.11	412.09	20	
99.71	8082.82	3823.21	886	Total
2.56	**207.25**	**98.03**	**22.71**	Average

Standard Deviation (previous yields): 137.12 Standard Deviation (recent yields): 84.45

Citrus Farming System – Yield per hectare

Area of Land (Hectares)	Previous yield (Kg/ha)	Current yield (Kg/ha)	Age of Citrus Stand (years)	
0.61	4118.42	2471.05	15	
2.83	5295.12	5295.12	15	
3.44	9413.54	7766.17	30	Total
1.72	**4706.77**	**3883.09**	**15**	Average