

## The Mining Sector in Ghana-Perspectives of Socio-Economic and Environmental Impacts

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**Abstract:** Developing countries depend mainly on the economic contribution of mining industry. In Ghana, the industry in 2011 contributed 5.5% of gross domestic product and 14% of taxes revenue. Export receipt appreciated by 60% in that same year which was mostly driven by an increase in export gains from gold production and crude oil petroleum export. Environmental problems associated with mining are of great concern in the country. The aim of this study was to analyze the perception of socio-economic benefits and environmental implications using a field survey in mining and non-mining communities (Tarkwa, Prestea Bogoso and Accra, Cape Coast, Ho, respectively). A Chi-square Goodness-of-Fit test was employed to analyze data on demographic information of respondents. The analyzed data indicated that positive responses were expressed on significant contribution of mining to the economy and communities, respectively. Negative responses were shown on environmental issues and its management by regulatory institutions and other stakeholders.

**Key words:** Mining, contributions, environment impacts, compensation, dependency, pollution

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### INTRODUCTION

Ghana is endowed with lot of natural resources. It is located on the West of Africa with population of 25 million and is a lower middle income state. Neighboring countries are Ivory Coast, Togo, Burkina Faso and Gulf of Guinea on the South. It is democratic country which had its independence on 6th March, 1957 under the leadership of the late Dr. Kwame Nkrumah. There was various coups detat and civilian governments till 1992 when the fourth republic started. There has been six successive elections since the 1992 constitution came into been. The stability, democratic and hospitality of Ghanaians has made the nation a business destination in Africa, especially in the Sub-Saharan. The nation has seen an upsurge of multination business over the years after introduction of Economic Recovery Programs/Structural Adjustment Programs, especially in the mining sector. Mining in Ghana dated back over 2000 years with the use of local equipment or tools. In fact, this method of mining got the Arab traders into the country and gave Ghana the name Gold Coast previously known (Botchway, 1995). A major economic activity in most developing countries is mining. These mining activities, either on large or small-scale are

intrinsically destructive to the environment (Makweka and Ndonde, 1996) which may generate many quantities of waste for decades with deleterious impacts. There are a number of common stages or activities of mining of which each has potentially negative effects on society and cultural heritage, natural environment, safety and health of workers in the mine and communities close to mining operations (Akabzaa, 2001). According to Noronha (2001), environmental and social effects are more distributive in places where mining activities are newly-estimated or otherwise shutting down. Potentially-negative impacts of mining activity has been established by several researchers which involves displacement of indigenous people from their ancestral lands, marginalization and subjugation of lower economic classes of people. During the 14th-19th centuries, Gold Coast manufactured about 14 million ounces of gold with the use of traditional tools and methods. The British in 19th century pave the way for modern technologies after they took over the Ashanti Kingdom (Ayensu, 1997). The introduction of modern methods of extracting minerals made gold mining an important foreign-run enterprise.

Many case-studies of community-based effect of the yellow precious metal extraction has been effectively

documented from different countries; Kenya (Ogola *et al.*, 2002), Papua New Guinea (Banks, 2002), Tanzania (Kitula, 2006), Peru (Muradian *et al.*, 2003) and Indonesia (Hills and Welford, 2005). In 2006, Kumah analyzed the sustainability of the gold extraction sector in Ghana. Outcome of the research indicated gold mining in the country manifests contradictions such as helping the entire economy of Ghana (macro level) but environmental and social problems are felt by individual communities (micro level). In addition, the case study indicated gold extraction sector employed small number of Ghanaians, in other cases dislodging farmers and inhabitant small-scale miners. Some environmental impacts identified by him are cyanide pollution, land degradation and dust pollution whilst socio-economic impacts associated with the sector include chronic impoverishment, social distraction, reduced access to important social and public services, loss of land and resources as a result of community relocation and human rights abuses (Kumah, 2006). Due to researches of this kind, there is growing communities' resistance to mining activities which assumes an increasing recognition (Hilson and Nyame, 2006). Garvin *et al.* (2009), also researched into community-company relation in Ghana and communities' perceptions of economic, socio-cultural and environmental impacts of gold mining. Findings of the research indicated communities held companies responsible for a series of economic, social and environmental changes. Whiles recognizing some of the benefits brought by the mines, communities felt that the companies did not live up to their responsibility to support local development. Mining companies replied by dismissing their concerns, denying or better, shifting blame to other parties (Garvin *et al.*, 2009). Aryee *et al.* (2003), pinpointed some policy options to address environmental issues in the mining industry. These policies are: moral suasion, regulation-legal requirement enforcement as a result of monitoring and policing, manipulation of market forces and assistance in investment in small-scale miners to enhance their operations (Aryee *et al.*, 2003). The purpose of this study is to evaluate perspectives of professionals, non-professions and the general populace in relation to socio-economic impact of mining to the economy and environmental implications in the sector.

**Economic and social benefits of mining:** Ghana is the 10th largest gold producer in the world and second in Africa after South Africa. It also produces other minerals such as aluminum metal and manganese ore, bauxite, diamond and others like kaolin, limestone, salt, sand, gravel and current crude oil (George, 2012). In 2011, total Ghana's export

receipt appreciated by 60% to the amount of US \$12.8 billion and most of this increase was driven as a result of increase in export gains from gold sector coupled with the beginning of crude oil petroleum export. Export earnings from gold which accounted for 38% of overall export gains, appreciated by 29.4% to US \$4.9 billion. The sector accounted for 5.5% of Gross Domestic Product (GDP) and 14% of total tax revenue (Bank of Ghana, 2012). Gold, diamond, bauxite and manganese are four major minerals produced. As at 2011, Ghana was identified as the 13th World diamond producer in terms of quantity (George, 2012). The mining sector contributes 38% of the total annual foreign exchange earnings to the country's economy, 5% of country's population is employed by the sector and provides 12% of total revenue collected by the nation's largest tax collector, Ghana Revenue Authority (GRA). Ghana's mineral sector appreciated by 10.4% in 2010 and in the same year approximately accounted for 11% of fiscal receipts by Ghana Revenue Authority. In large-scale mining sector, approximately 20,000 Ghanaians were directly employed with 6,000 providing services to the industry whilst over 500,000 were engaged in small-scale diamond mining, gold and other industrial minerals for construction sector (MFEP, 2010, 2011; African Economic Outlook, 2011). Since, commencement of reforms, the mining industry on a whole provides 50% of foreign direct investment flows into the economy. These statistics of the sector changes from year to year (Baah, 2005). The huge investments over the years and its consequent mineral outputs led to an appreciated sectorial impact to the economy of which 27% of Government revenue was collected by the Ghana Revenue Authority in 2012 (Minerals Commission, 2013). However, social impact is of much concern to both companies and other stakeholders. In pursuit of this, several developmental policies and guidelines to address issues in the mining industry were introduced such as compensation policy, corporate social responsibility guidelines for mining companies in mining communities, establishment of baseline data on social conflicts, guidelines on use of mineral royalties by district/municipal assemblies and mine closure and post closure policy.

In spite of significant investments of the sector into the economy, companies have invested into major social projects or corporate social responsibilities projects to support governmental efforts by developing catchments and non-catchments communities. Companies have embraced corporate social responsibilities as part of core objectives and key targets of projects by mining companies includes economic empowerment, infrastructural development, environmental issues, education and training, health and safety, etc. Over

US \$113 million was spent from 2004-2011 by the mining industry to implement corporate social responsibility projects (Minerals Commission, 2013).

Minerals Development Fund (MDF) was established in October 1992 and started operating in 1993 with aim of linking up with and extends benefits of mining to communities especially within vicinity of mines. This fund aimed at development projects to improve conditions in mining communities and also to fund part of budgets of Mining Sector Institutions in addition to research and projects approved in the minerals sector as a whole. From 1993-1998, total of US \$16,824,189 was disbursed to local communities in which mining takes place through the MDF and this fund comes from 20% mineral royalties collected by the state. Several alternative livelihood projects have been sponsored by Ghana Government of which the Prestea Huni-Valley oil palm project is one. This project covers 23,000 acres of oil palm plantation and employed 23,000 people. This is significant commitment from the government to provide alternative livelihood income earning projects to communities.

**Environmental issues:** Though, mining industry contributes significantly to the economy, externalities of the sector are of much concern for Ghanaians. Some serious environmental implications of mining are: pollution of water bodies with cyanides and other heavy metals, dust and air pollution, etc. These problems deprive communities of potable drinking in addition to health diseases. Wassa Association of Communities Affected by Mining (WACAM) a non-governmental organization noted that 250 rivers had been polluted by these mining companies. The 1992 constitution of Ghana entreats the country to adopt appropriate steps to promulgate regulatory instruments or laws to protect the national environment for posterity and cooperate with other nations and institutions to safeguard the international environment for the purpose of protecting broader international environments for mankind (Quashigah, 1992). In order to regulate and management the sector effectively and efficiently several laws or legal instruments have been promulgated or reviewed to aid this process after the liberalization and reform of the sector in 1983. Based on the provision of 1992 Constitution, Parliament of Ghana passed the Environmental Protection Agency (EPA) Act in 1994 (Act 490) to regulate the sector. This agency has basic task to perform in line of its duties as to ensure environmental permits and pollution abatement notice in compliance with any laid down environmental impact assessment procedures in the planning and execution of development projects and existing project compliance.

Various auxiliary legislations on the environment have been issued by the body as Environmental Impact Assessment, Environmental Audit and Management Plans based on the Act 490 of Environmental Protection Agency. Environmental Protection Council (EPC) though established in 1974, it was an advisory body till 1994 when had full agency ship with all powers to regulate environment. The council began as department under Finance Ministry, later reshuffled under various ministries until 1992 when it had its own Ministry of Environment before been transformed into Ministry of Environment, Science and Technology (Akabzaa and Darimani, 2001). Annual losses to the economy was estimated in 1988 by quantifying it as to the environmental degradation and conservative estimate amounted to 41.7 billion Ghana cedis which represents equivalent of 4% of country's overall GDPs (Coakley, 1998). To ensure safety and environmental standards of the sector, Environmental Protection Agency in 2011 adopted the AKOBEN to monitor environmental and social issues of mining companies. The name AKOBEN is a symbol adopted from Ghana's traditional Adinkra symbols and signifies Vigilance and Wariness that is a set of behaviors which is pertinent for issue of environmental and conservation (Afsah *et al.*, 1997). For Environmental Protection Agency (EPA) to control mining companies effectively, AKOBEN system was design with >100 performance indicators which has qualitative and quantitative data as well as visual information assigned to rate, monitor, assess and disclose environmental performance of mining companies in the sector to conform to international standard. Based on objectives of Ghana National Environmental Policy to find and implement an appropriate incentives and sanctions to enforce and ensure compliance regulations in the industry (Allotey *et al.*, 2011).

The rating method adopted by AKOBEN in the mining sector considers environmental performance of a company into five code colors which can be communicated easily to the public at large. These colors are gold, green, blue, orange and red. Garvin *et al.* (2009), also researched into perception of environmental impacts of mining on air quality, noise, land vibration and overall degradation by which responses from companies indicated their performances and activities are being monitored by Environmental Protection Agency and they meet all international environmental quality standards. Companies contacted in the survey reacted to communities allegation of increase in disease and water shortage in communities as a result of influx of new population (which was not attributed to their operations) and companies have provided communities with boreholes and wells but poor management and

irresponsible behaviors are responsible for continuous water shortage (Garvin *et al.*, 2009). There is growing strong perception of the sector not living up to its expectations in relation to contribution to development and environment related issues.

## MATERIALS AND METHODS

The research sample includes professionals, non-professional and the general public who are one way or the other linked to the sector. Among them are managers, technicians, qualified (blue color) workers, journalist, social scientists, etc. The aim is to get as much as possible enough respondents from mining and non-mining communities to response to issues raised about the sector. Field survey was carried out in three mining and three non-mining communities (Tarkwa, Prestea, Bogoso and Accra, Cape Coast, Ho, respectively). This sample size describes falls within the target of the research to ascertain opinions of people in these communities and their knowledge relating to the sector. Standardized questionnaires were used to collect data aided with effective interaction with respondents. Combinations of various sample methods were applied to achieve this target. Purposive sampling was adopted which was defined as the participant are hand-pick from the accessible population (Gliner and Morgan, 2000). Respondents to questionnaires were approached in mining communities, institutions related to mining operations, tertiary institutions and other relevant populations. These correspondents were selected based on simple accessibility to the survey administer. According to Gliner and Morgan (2000), these participants are selected on the basis of convenience rather than chosen in a serious attempt to select participants who are representative of the theoretical population. In addition to the earlier method snowball sampling was used which has been defined as modification of convenience or accidental sampling, etc. People are asked for additional references according to Gliner and Morgan (2000). These techniques helped the researcher to administer questionnaires without too many constraints in identifying respondents for the survey. Total of 840 questionnaires were administered but 647 were collected representing 77% outcome of population contacted. Respondents were provided closed ended questions with possible responses such as 'excellent', 'very good', 'good' and 'poor' for rating of questions based on participants view.

### Mathematical model

**Contingency table:** The clear visualization of mutual relationship of two statistical characteristic is called

Table 1: General form of contingency table

| Parameters | $b_1$    | $b_2$    | ... | $b_s$    | Frequencies |
|------------|----------|----------|-----|----------|-------------|
| $a_1$      | $n_{11}$ | $n_{12}$ | ... | $n_{1s}$ | $n_{1+}$    |
| $a_2$      | $n_{21}$ | $n_{22}$ | ... | $n_{2s}$ | $n_{2+}$    |
| ...        | ...      | ...      | ... | ...      | ...         |
| $a_r$      | $n_{r1}$ | $n_{r2}$ | ... | $n_{rs}$ | $n_{r+}$    |
|            | $n_{+1}$ | $n_{+2}$ | ... | $n_{+s}$ | N           |

$a_i$  = Category of variable a (r number of categories);  $a_j$  = Category of variable b (s number of categories);  $n_{ij}$  = ( $i = 1, 2, \dots, r; j = 1, 2, \dots, s$ ) associated relative frequencies ( $p_{ij} = n_{ij} / n$ ) associated relative frequencies;  $n_{i+}$  = Marginal absolute row frequencies ( $p_{i+} = n_{i+}/n$  relative);  $n_{+j}$  = Marginal absolute column frequencies ( $p_{+j} = n_{+j}/n$  relative)

contingency table or cross tabulation. Rows of cross tabulation or contingency tables correspond with possible values of first characteristics and columns correspond with possible values of second characteristic. Appropriate cell of cross tabulation is assigned number of cases when at the same time the first characteristic had the value corresponding appropriate row and the second one have a value corresponding to appropriate column. An example of this characteristic can be sex of someone and the characteristic could be month of the person's birth. The cross tabulation is in a form of 2 rows (man, woman) and 12 columns (i.e., months of the year) which explains number of occurrences of every aggregation of exact sex and month in individual observed sets. It is possible for a row or column to correspond to more possible values of characteristic (Table 1). It happens in cases where characteristic acquire some specific values of which are rarely therefore is advisable to combine multiple possible values.

**Chi-square Goodness-of-Fit test:** This test is based on the premise that there are two independent characters which has a proportional distribution of frequency in cross tabulation to row and column marginal frequencies. It is a test known to be in conformity with observed and expected frequencies (Ott and Longnecker, 2010).

Null hypothesis;  $\pi_i = \pi_{i0}$  for categories  $i = 1, \dots, k$ ,  $\pi_{i0}$  are specific probabilities or proportion. Alternative hypothesis; it indicates a situation where at least a cell probability is different from the hypothesized figure. Test statistics:

$$\chi^2 = \sum \left[ \frac{(n_i - E_i)^2}{E_i} \right] \quad (1)$$

Where:

$n_i$  = The observed number in category  
 $i$  and  $E_i$  =  $n\pi_{i0}$  is the expected number under  $H_0$ .

**Rejection of null hypothesis:** Rejection  $H_0$  if  $\chi^2$  exceeds the tabulated critical value for specified  $\alpha$  and  $df = k-1$ .

**Assumption of Chi-square:** Cochran states that the approximation should be adequate if no  $E_i < 1$  and no more than 20% of the  $E_i < 5$ . The value of  $n/k$  that provide adequate approximation for the Chi-square Goodness-of-Fit test statistic tend to decrease as  $k$  increases” (Ott and Longnecker, 2010).

**Significance level:** To analysis categorical data of this research, we chose  $\alpha = 0.05$  (5%) as the significance level.

## RESULTS

To analysis data collected from field survey conducted, IBM Statistical Package for Social Sciences 20 (SPSS) Software was used. We sampled 647 respondents, 442 males and 205 females. Statistical analysis of total respondents indicated 41.4% are public sector workers, 37.7% private workers and 20.9% works in other sectors and the media. The demographic information of respondents was evaluated in six categories (i.e., gender, age, education, marital status, sector of employment and managerial level of respondents). Out of the respondents 35.7% are married, 61.2% are single and 3.1% are made of divorced and others. The percentages of respondents at managerial levels are as follows: 20.4% junior and others, 33.7% middle and 45.9% senior staffs. On education, 0.5% respondents acquired primary/high school education. Additionally, 43.0% had higher national diploma/degree and 56.6% had post-graduate education. The research data was collected in two different categories (socio-economic impact and environmental issues) on the mining sector and were analyzed with Chi-square Goodness-of-Fit test.

### Analysis of economic and socio-economic benefits:

- $H_0$ : mining companies do not contribute to communities development

Analyzed output of contributions of mining companies towards communities development with Chi-square Goodness-of-Fit test indicated statistically significant dependency on age, marital status and respondents Sector of Employment (SOE) excluding gender and managerial Level Within an Organization (LWO) (Table 2). There are evidence of relationship between contributions of mining companies toward community developments and three variables (age, marital status and SOE). All categories of responses except gender were merged into three choices because of less number of respondents and to meet required assumptions for Chi-square analysis. The null hypothesis was retained for gender and managerial Level Within an Organization (LWO) while rejected in significant parameters.

Table 2: Result of statistical analysis of opinion on contributions of mining companies to respective communities towards development dependency on gender, age, marital status, sector of employment and level within an organization

| Parameters     | df | Test criterion $\chi^2$ | p-values | Dependency |
|----------------|----|-------------------------|----------|------------|
| Gender         | 3  | 1.04                    | 0.79     | No         |
| Age            | 6  | 13.10                   | 0.04     | Yes        |
| Marital status | 6  | 13.57                   | 0.04     | Yes        |
| SOE            | 6  | 17.33                   | 0.00     | Yes        |
| LWO            | 6  | 11.64                   | 0.07     | No         |

Table 3: Output of statistical analysis of contributions of mining companies to nation development dependency on gender, age, marital status, sector of employment and level within an organization

| Parameters     | df | Test criterion $\chi^2$ | p-values | Dependency |
|----------------|----|-------------------------|----------|------------|
| Gender         | 3  | 3.83                    | 0.28     | No         |
| Age            | 6  | 10.47                   | 0.11     | No         |
| Marital status | 6  | 24.88                   | 0.00     | Yes        |
| SOE            | 6  | 23.64                   | 0.00     | Yes        |
| LWO            | 6  | 7.50                    | 0.28     | No         |

Field survey, 2013. df = Degree of Freedom, SOE = Sector of Employment, LWO = Managerial level Within an Organization

Respondents view on contribution of mining companies to immediate community development was analyzed according to demographics of participants of the survey. Opinions sampled in percentage terms indicated mining companies impact positively on communities development as 39.7% rated companies impact as good, 27.4% population sampled viewed it as poor, 23.2% as very good and 9.7% as excellent contribution from the industry.

- $H_0$ : mining companies do not contribute to the nation's development

In testing mining companies contributions to the economy development of Ghana with Chi-square Goodness-of-Fit test, it indicated statistically significant dependency on marital status and sector of employment excluding gender, age and managerial level within an organization (Table 3). We noticed very strong evidence to support the relationship between nation's development by mining companies and two variables (marital status and SOE). Null hypothesis was retained for gender, age and managerial level within an organization while the remaining two were rejected since it's statistically significant. Respondents view on contribution of mining sector to development according to all variables indicated 41.9% of sample population as good, 29.5% as very good, 21.3% rated their impact on economy development as poor and finally 7.3% responded as excellent input to nation's development.

- $H_0$ : the mining sector do not provide infrastructure

Table 4: Result of statistical analysis of infrastructure provided by mining sector dependency on gender, age, marital status, sector of employment and level within an organization

| Infrastructure provided by mining sector |    |                         |          |            |
|--|----|-------------------------|----------|------------|
| Parameters                               | df | Test criterion $\chi^2$ | p-values | Dependency |
| Gender                                   | 3  | 1.28                    | 0.74     | No         |
| Age                                      | 6  | 7.80                    | 0.25     | No         |
| Marital status                           | 6  | 15.14                   | 0.02     | Yes        |
| SOE                                      | 6  | 16.93                   | 0.01     | Yes        |
| LWO                                      | 6  | 16.60                   | 0.01     | Yes        |

Table 5: Outcome of statistical analysis of opinion on compensation paid to farmers and others due to negative impact of mining dependency on gender, age, marital status, sector of employment and level within an organization

| Compensation paid to farmers and others agencies as a result of negative impact of mining |    |                         |          |            |
|---|----|-------------------------|----------|------------|
| Parameters  | df | Test criterion $\chi^2$ | p-values | Dependency |
| Gender  | 3  | 0.63                    | 0.89     | No         |
| Age   | 6  | 6.68                    | 0.35     | No         |
| Marital status  | 6  | 14.15                   | 0.03     | Yes        |
| SOE   | 6  | 12.54                   | 0.05     | Yes        |
| LWO   | 6  | 8.91                    | 0.18     | No         |

Field Survey, 2013; df = Degree of Freedom; SOE = Sector of Employment; LWO = Managerial level Within an Organization

Data analyzed on infrastructure provided by mining companies indicated three parameters were statistically significant dependency on marital status, sector of employment and managerial level within an organization while gender and age were statistically insignificant. Evidence of dependency can be seen between infrastructure provided by mining sector in Ghana and three out of five variables (marital status, SOE and LWO) (Table 4). The null hypothesis was rejected in case of marital status, sector of employment and managerial level within an organization while other two parameters were retained. Statistical analysis of responses from respondents on infrastructure provided by mining sector in communities and the country was assessed. Results from sampled data rated provision of infrastructure (road, school, health posts, etc.) as good with 39.3 and 26.7% of sampled population rated it as poor, 25.2% as very good and finally, 8.8% of participants of the survey rated infrastructure as excellent impact from the sector.

- $H_0$ : mining companies do not compensate farmers and other respective/relevant agents for negative impact of their operations

Statistical data analyzed on opinion of compensation paid by mining companies to farmers and others relevant agents as a result of negative impact of mining activities dependency on marital status and sector of employment indicated statistically significant (Table 5). There is

Table 6: Result of statistical analysis of opinion on standard of living of people in mining communities' dependency on gender, age, marital status, sector of employment and level within an organization

| Standard of living of people in mining communities |    |                         |          |            |
|--|----|-------------------------|----------|------------|
| Parameters   | df | Test criterion $\chi^2$ | p-values | Dependency |
| Gender   | 3  | 5.56                    | 0.14     | No         |
| Age  | 6  | 4.80                    | 0.57     | No         |
| Marital status                                     | 6  | 30.47                   | 0.00     | Yes        |
| SOE  | 6  | 21.98                   | 0.00     | Yes        |
| LWO  | 6  | 9.81                    | 0.13     | No         |

Field survey, 2013; df = Degree of Freedom; SOE = Sector Of Employment; LWO = Managerial level Within an Organization

evidence to support relationships between compensation paid to farmers, other agencies and two variables (marital status and SOE). Null hypothesis in relation to marital status and sector of employment were rejected while in terms of gender, age and managerial level within an organization were retained because they were insignificant. Respondents opinion on compensation paid to farmers and relevant agents, as a result of negative impact of mining was analyzed. Output of data indicated 42.3% participants rated compensation paid to farmers and other relevant agents as poor, 29.4% agreed it was good compensation, 16.8% saw it as very good and 11.4% respondents graded compensation as excellent to farmers and related agents.

Analyzing standard of living of people in mining communities with chi square goodness of fit test attested statistically significant dependency on marital status and sector of employment with exception of gender, age and managerial level within an organization (Table 6). There are very strong evidence of dependency between standard of living of people in mining communities and two parameters (marital status and SOE). Respondents perspectives on standard of living of people in mining communities were analyzed with respect to demographic information. Total of 38.9% respondents rated standard of living as poor, 31.1% rated it as good, 21.1% indicated it as excellent and finally 18.0% of sampled population rated standard of living in mining communities as very good.

#### Analysis of environmental implications:

- $H_0$ : mining companies do not pollute water bodies

The use of Chi-square to analysis opinions on pollution of water bodies by mining companies dependency on gender, age, SOE and LWO indicated statistically insignificant in exception of marital status which was significant. There is very strong evidence to support the relationship between pollution of water bodies by mining companies and marital status out of

Table 7: Result of analysis on pollution of water bodies by mining companies with dependency on gender, age, marital status, sector of employment and level within an organization

| Pollution of water bodies by mining companies |    |                         |          |            |
|---|----|-------------------------|----------|------------|
| Parameters                                    | df | Test criterion $\chi^2$ | p-values | Dependency |
| Gender  | 3  | 0.93                    | 0.82     | No         |
| Age   | 6  | 10.52                   | 0.11     | No         |
| Marital status                                | 6  | 24.77                   | 0.00     | Yes        |
| SOE   | 6  | 5.92                    | 0.43     | No         |
| LWO   | 6  | 11.25                   | 0.08     | No         |

Table 8: Result of attitude of mining companies towards pollution apart from water bodies with dependency on gender, age, marital status, sector of employment and level within an organization

| Attitude of mining companies towards pollution apart from water bodies |    |                         |          |            |
|--|----|-------------------------|----------|------------|
| Parameters   | df | Test criterion $\chi^2$ | p-values | Dependency |
| Gender   | 3  | 1.88                    | 0.60     | No         |
| Age  | 6  | 11.45                   | 0.08     | No         |
| Marital status   | 6  | 14.56                   | 0.02     | Yes        |
| SOE  | 6  | 17.14                   | 0.01     | Yes        |
| LWO  | 6  | 14.22                   | 0.03     | Yes        |

Field survey, 2013; df = Degree of Freedom; SOE = Sector Of Employment; LWO = Managerial level Within an Organization

five parameters analyzed (Table 7). Null hypothesis was retained in insignificant parameters and rejected in marital status. Statistical analysis based on demographic information of respondents on pollution of water bodies by mining companies according to opinions of respondents indicated mining companies really pollute water bodies in Ghana. Total of 65.8% participants rated pollution of water bodies as poor, 14.2% rated it as good, 10.8% sampled analyzed on attitude of mining companies with respect to other pollutions (noise, vibration, air, etc.) depende population rated water pollution as very good and 9.1% rated pollution of water bodies by mining companies as excellent.

The various parameters ncy on marital status, SOE and LWO proved statistically significant whilst gender and age indicated insignificant. We identified evidence of association with attitude of mining companies towards pollution apart from water bodies and three parameters (marital status, SOE and LWO) (Table 8). Attitude of mining companies towards other pollutions in exception of water bodies received same responses from respondents on all parameters evaluated (gender, age, marital status, SOE and LWO). Total of 54.1% sampled size rated attitude of mining companies towards other pollution as poor, 25.7% indicated it as good whilst 12.1% rated companies attitude towards pollution as very good. Finally, 8.2% respondents rated their attitude towards other pollutions as an excellent effort.

Opinions evaluated on duties and responsibilities of Environmental Protection Agency (EPA) with Chi-square Goodness-of-Fit test dependency on marital status and SOE indicated statistically significant. There are evidence

Table 9: Analyzing opinion on duties and responsibilities of environmental protection agency with dependency on gender, age, marital status, sector of employment and level within an organization

| Duties and responsibilities of Environmental Protection Agency (EPA) |    |                         |          |            |
|--|----|-------------------------|----------|------------|
| Parameters   | df | Test criterion $\chi^2$ | p-values | Dependency |
| Gender   | 3  | 5.74                    | 0.13     | No         |
| Age  | 6  | 7.30                    | 0.29     | No         |
| Marital status   | 6  | 16.26                   | 0.01     | Yes        |
| SOE  | 6  | 14.41                   | 0.03     | Yes        |
| LWO  | 6  | 5.23                    | 0.52     | No         |

Table 10: Analyzing opinion on international environmental standards of waste disposal by mining companies with dependency on gender, age, marital status, sector of employment and level within an organization

| International environmental standard of waste disposal by companies |    |                         |          |            |
|---|----|-------------------------|----------|------------|
| Parameters  | df | Test criterion $\chi^2$ | p-values | Dependency |
| Gender  | 3  | 4.26                    | 0.24     | No         |
| Age   | 6  | 11.69                   | 0.07     | No         |
| Marital status  | 6  | 11.18                   | 0.08     | No         |
| SOE   | 6  | 27.33                   | 0.00     | Yes        |
| LWO   | 6  | 9.71                    | 0.14     | No         |

Field survey, 2013; df = Degree of Freedom; SOE = Sector Of Employment; LWO = Managerial level Within an Organization

of dependency between duties and responsibilities of EPA and two out of five variables analyzed (marital status and SOE) (Table 9). Perceptions on duties and responsibilities of EPA as regulatory institution to monitor evaluate and regulate activities of mining companies and other agents related to environmental issues in relation to demographic information of respondents were analyzed. Results from the analysis indicated 38.2% respondents rated performance of EPA institution good, 32.1% indicated performance of EPA as poor. In addition, 23.5% respondents rated it as very good and 6.2% as excellent performance of the agency to monitor and evaluate activities of the sector.

- $H_0$ : mining companies do not adhere to international standards in disposal of waste

Assessment of opinions on adherence of international environmental standard of waste disposal by mining companies dependency on SOE proved to be statistically significant by  $\chi^2$ -test. There is very strong evidence of relationship with adherence of international environmental standard of waste disposal by mining companies and SOE out of five variables of respondents analyzed (Table 10). We retained null hypothesis for gender, age, marital status and level within an organization. Analyzed data on adherence of international environmental standard of waste disposal by mining companies in the industry indicated 43.7% of

respondents rated mining companies waste disposal as poor 28.9% rated adherence to international standard of waste disposal as good 18.2% sampled population graded it as very good and finally 9.1% respondents rated mining companies adherence to international environmental standards of waste disposal in the sector as excellent.

Analyzed views on communities co-operation with mining companies to manage the environment dependency on age proved statistically significant. There is evidence of dependency between communities co-operation with mining companies to management environment and age out of five parameters of respondents analyzed (Table 11). Response from participants of the survey on communities cooperation's with mining companies towards management of the environment was evaluated on all variables (gender, age, marital status, SOE and LWO) of respondents. Total of 40.0% respondents rated co-operation between mining companies and communities effort towards environment as good, 38.8% rated co-operation between them as poor, 20.1% indicated it as very good and 8.0% rated cooperation between them as poor in relation to management of environment.

Statistical analysis of personnel and resources of EPA to attain its duties and responsibilities dependency on gender and marital status proved statistically significant. There are evidence of relationship between personnel and resources of EPA to achieve duties/responsibilities and two variables (gender and marital status) (Table 12). Data collected and analyzed on

whether EPA has personnel and resource to accomplish its objective effectively in the mining sector and other related environmental obligations received a mixed results from respondents. Responses from 19.5% respondents agreed the agency has personnel and resources while 37.9% disagreed with 42.7% respondents of the survey slightly agreed EPA has personnel and resources to accomplish the organization objectives.

## DISCUSSION

The outcomes of this research indicate enormous benefits associated with minerals extraction sector to the economy of Ghana. Respondents of the survey considered economic, social benefit and environmental implications of the sector. The result is in line with Garvin *et al.* (2009)'s where community members considered economic, social and environmental impacts of development (Garvin *et al.*, 2009). According to Banks (2002), the indigenous cares about environmental effects but social and economic impacts of mining industry are of equal or greater important (Banks, 2002). Broader disregard of this set of concerns by companies may contribute to misunderstanding between local mines and community members (Ballard and Banks, 2003). Throughout the study, participants expressed different perspectives on economic, social benefits and environmental impacts in the industry. Most factors with respect to economic and corporate social responsibility by respondents appeared to influence perspectives of participants which include contribution of companies to communities and nation's development and provision of infrastructure. Some of these factors were identified by Garvin *et al.* (2009), Downing *et al.* (2002), Epps (1997), Salami and Tsekor (2000) and Veiga *et al.* (2001). Negative perceptions were expressed by respondents on standard of living of locals in mining communities as well as poor compensation paid to farmers and other related agents as a result of negative impact of mining operations. Companies have embraced corporate social responsibilities as an effective tool of creating good relationship between communities and companies. This has been proven based on positive perspectives expressed on the social benefits from the sector by participants of the survey. Despite the industry's input to nations economy, responses from the survey shows that environmental impact are of significant important to the society and it must be considered for the sector to thrive effectively. Views expressed on pollution of water bodies by companies, attitude towards other pollutions (noise, air, etc.) and adherence to international environmental standards in relation to waste disposal were negative and these externalities were identified by Epps (1997),

Table 11: Analyzing communities co-operations with mining companies on environmental management dependency on gender, age, marital status, sector of employment and level within an organization

| Communities co-operation with mining companies to manage environment |    |                         |          |            |
|--|----|-------------------------|----------|------------|
| Parameters   | df | Test criterion $\chi^2$ | p-values | Dependency |
| Gender   | 3  | 1.15                    | 0.77     | No         |
| Age  | 6  | 14.55                   | 0.02     | Yes        |
| Marital status   | 6  | 7.02                    | 0.32     | No         |
| SOE  | 6  | 12.05                   | 0.06     | No         |
| LWO  | 6  | 6.28                    | 0.39     | No         |

Table 12: Analyzing personnel and resources of EPA to achieve task with dependency on gender, age, marital status, sector of employment and level within an organization

| Personnel and resources of EPA to achieve duties and responsibilities |    |                         |          |            |
|---|----|-------------------------|----------|------------|
| Parameters  | df | Test criterion $\chi^2$ | p-values | Dependency |
| Gender  | 3  | 5.89                    | 0.05     | Yes        |
| Age   | 4  | 5.26                    | 0.26     | No         |
| Marital status  | 4  | 10.69                   | 0.03     | Yes        |
| SOE   | 4  | 6.45                    | 0.17     | No         |
| LWO   | 4  | 6.64                    | 0.16     | No         |

Field survey, 2013; df = Degree of Freedom; SOE = Sector of Employment; LWO = Managerial level Within an Organization



Garvin *et al.* (2009), Humphreys (2001), Akabzaa and Darimani (2001) and Downing *et al.* (2002). In relation to performance of various institutions assigned to manage the sector, respondents appreciate their effort despite some reservations about their effectiveness. The Environmental Protection Agency, in 2011, took steps to assess performances of companies in terms of socio-economic and environmental performance (Allotey *et al.*, 2011). The action of EPA was to keep the sector alert on its operations and role of protecting the environment.

### CONCLUSION

Respondents appreciated input of mining sector to the economy and its social benefits at large. Nevertheless, poor management of the environment is of great concern to locals and the entire nation. Basically, there were positive remarks on contribution of mining to communities and national development, provision of infrastructure while respondents reacted negatively towards pollution of water bodies, less compensation paid to farmers and other relevant agents, etc.

### RECOMMENDATIONS

Based on effective interactions with respondents of the survey, we recommend the following strategies for relevant policy makers to adopt:

- Minerals Commission, the Ghana Chamber of mines and other stakeholders should engage the public and the media regularly, at least twice a year, to educate them on environmental measures taken by mining companies and regulatory institutions to protect water bodies and other negative (externalities) impacts of mining in the sector
- Frequent monitoring of mining companies on adherence of international laws on waste disposal and companies found to default these procedures should be prosecuted according to laws of the land as well as institute the payment of huge damages for pollution of the environment
- Information made available to researchers indicated that Environmental Impact Assessment, a role of the Environmental Protection Agency (EPA) which has been ceded to the mining companies owing to insufficient or non-existing resources should be reverted to the EPA but this time with funding of the exercise coming from the mining companies it is something they do by themselves regularly. This will reduce the high level of bias in their reports which do not paint a good picture of the actual situation on the ground

- Further recommend that before mining licenses are given to these mining companies to commence operation a critical focus should be on the aspects of their business plans that has to do with waste control and management as a result of their activities. Finally, a follow up research would consider large sample size of all ten administrative regions of Ghana with more variables and carry out other multidimensional statistical model of respondents perspectives of the sector compared with this research

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### REFERENCES

- African Economic Outlook, 2011. Ghana 2011. Moulinaux, France, Africa Economic Outlook.
- Afsah, S., B. Laplante and D. Wheeler, 1997. Regulation in the information age: Indonesia's program or environmental management. World Bank, March 1997. <http://siteresources.worldbank.org/NIPRINT/Resources/RegulationInTheInformationAge.pdf>.
- Akabzaa, T. and A. Darimani, 2001. Impact of mining sector investment in Ghana: A study of the tarkwa mining region. Report on Structural Adjustment Participatory Review Initiative (SAPRI), Ghana, January 20, 2001.
- Akabzaa, T.M., 2001. Boom and Dislocation: The Environmental and Social Impacts of Mining in the Wassa West District of Ghana. Third World Network- Africa, Accra, Ghana, ISBN-13: 9789988602994, Pages: 144.
- Allotey, J., R. Sekyi, L. Faabeluon, E.N. Erquaye-Tetteh and H.H. Affull *et al.*, 2011. Track E: Non-traditional approaches integration of environmental disclosure into regulatory management: The case of the akoben environmental rating programme. Proceedings of the 9th International Conference for Environmental Compliance and Enforcement, June 20-24, 2011, Whistler, British Columbia, pp: 527-538.
- Aryee, B.N., B.K. Ntibery and E. Atorkui, 2003. Trends in the small-scale mining of precious minerals in Ghana: A perspective on its environmental impact. J. Cleaner Prod., 11: 131-140.
- Ayensu, E.S., 1997. Ashanti Gold: The African Legacy of the World's Most Precious Metal. Marshal Editions Developments Ltd., Italy, ISBN-13: 978-1840282757, Pages: 200.

- Baah, A., 2005. Assessing Labor and Environmental Standards in South African Multinational Companies in the Mining Industry in Africa: The Case of Goldfields South Africa. In: Mining Africa, Comprehensive Report on South African MNCs Labor and Social Performance, Pillaly, D. (Ed.). National Labour and Economic Development Institute, Johannesburg, pp: 176-179.
- Ballard, C. and G. Banks, 2003. Resource wars: The anthropology of mining. *Ann. Rev. Anthropol.*, 32: 287-313.
- Bank of Ghana, 2012. 2011 annual report: Accra. Ghana Bank of Ghana, pp: 38.
- Banks, G., 2002. Mining and the environment in Melanesia: Contemporary debates reviewed. *Contemp. Pacific*, 14: 39-67.
- Botchway, F.N., 1995. Pre-colonial methods of gold mining and environmental protection in Ghana. *J. Energy Nat. Resour. L.*, 13: 299-311.
- Coakley, G.J., 1998. The mineral industry of Ghana. *International Minerals Statistics and Information*, US Geological Survey.
- Downing, T.E., J. Moles, I. McIntosh and C. Garcia-Downing, 2002. Indigenous people and mining: Strategies and tactics for encounter. *International Institute for Environment and Sustainable Development (IIESD)*, London, UK., April 2002.
- Epps, J.M., 1997. The social agenda in mine development. *Ind. Environ.*, 20: 32-35.
- Garvin, T., T.K. McGee, K.E. Smoyer-Tomic and E.A. Aubynn, 2009. Community-company relations in gold mining in Ghana. *J. Environ. Manage.*, 90: 571-586.
- George, M.W., 2012. Gold: U.S. Geological Survey Mineral Commodity Summaries, pp: 66-67.
- Gliner, J.A. and G.A. Morgan, 2000. *Research Methods in Applied Settings: An Integrated Approach to Design and Analysis*. Lawrence Erlbaum Associates, Mahway, New Jersey.
- Hills, J. and R. Welford, 2005. Profits, pollution and prison: A case study of gold mining in Indonesia. *Corporate Soc. Responsibility Environ. Manage.*, 12: 105-113.
- Hilson, G. and F. Nyame, 2006. Gold mining in Ghana's forest reserves: A report on the current debate. *Area*, 38: 175-185.
- Humphreys, D., 2001. Sustainable development: Can the mining industry afford it? *Resour. Policy*, 27: 1-7.
- Kitula, A.G.N., 2006. The environmental and socio-economic impacts of mining on local livelihoods in Tanzania: A case study of Geita District. *J. Cleaner Prod.*, 14: 405-414.
- Kumah, A., 2006. Sustainability and gold mining in the developing world. *J. Cleaner Prod.*, 14: 315-323.
- MFEP., 2010. Aggregation/reconciliation of mining sector payments and receipts 2004-2008. Ministry of Finance and Economic Planning, October, Accra, Ghana.
- MFEP., 2011. Budget statement and economic policy for finance year 2011. Ministry of Finance and Economic Planning, Accra, Ghana.
- Makweka, M.M. and P.B. Ndonde, 1996. The mineral sector and the national environment policy. *Proceedings of the Workshop on the National Environment Policy for Tanzania*, July 24, 1996, Dar Salaam, Tanzania, pp: 164-173.
- Minerals Commission, 2013. The economic and social impacts of mining in Ghana. Reporting on the extractive industries; Training working for journalists and editors, Accra, Ghana, April 13.
- Muradian, R., J. Martinez-Alier and H. Correa, 2003. International capital versus local population: The environmental conflict of the Tambogrande mining project, Peru. *Soc. Natl. Resour.*, 16: 775-792.
- Noronha, L., 2001. Designing tools to track health and well-being in mining regions of India. *Natl. Resour. Forum*, 25: 53-65.
- Ogola, J.S., W.V. Mitullah and M.A. Omulo, 2002. Impact of gold mining on the environment and human health: A case study in the migori gold belt, Kenya. *Environ. Geochem. Health*, 24: 141-157.
- Ott, L.R. and M. Longnecker, 2010. *An Introduction to Statistical Methods and Data Analysis*. 6th Edn., Cengage Learning, Belmont CA.
- Quashigah, K., 1992. The 1992 constitution of Ghana. [http://www.icla.up.ac.za/images/country\\_reports/ghana\\_country\\_report.pdf](http://www.icla.up.ac.za/images/country_reports/ghana_country_report.pdf).
- Salami, M.B. and A. Tsekor, 2000. Socio-economic baseline study of communities in the catchment area of productive mining sites in ashanti and western regions in Ghana. The Ghana Chamber of Mines, Accra, Ghana.
- Veiga, M.M., M. Scoble and M. McAllister, 2001. Mining with communities. *Nat. Resour. Forum*, 25: 191-202.