

## Farmers Education and Risk Perceptions of Large-Scale Mining in Ghana

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### Abstract

Empirical studies that use household farmers as unit of analysis to examine the relative influence of education on risk perceptions of large scale mining projects in Ghana are virtually absent. This study combined evidence from literature, mixed methods, *Pearson's Chi square* ( $X^2$ ) and correlation analyses. Systematic random sampling was used in selecting farmers. Data obtained from 725 households was analyzed using SPSS. The hypothesis "education has no relationship with farmers' risk perceptions of large-scale mining projects in Ghana" was tested. Results revealed that large-scale mining has both positive and negative image in the minds of farmers. Farmers' education strongly correlated with their knowledge of the state of the environment and natural resources before the arrival of the mining project [*Pearson's* ( $X^2$ ) = 26.743;  $p = 0.024$ ; *Pearson's* ( $r$ ) = 0.791;  $p = 0.010$ ]. Statistical evidence exists to support the claim that local communities protested against the mining project due to their ability to anticipate adverse effects of the project on environmental quality. Education significantly influenced farmers' ability to link sources of livelihood to environmental and resource protection [*Pearson's* ( $X^2$ ) = 25.516,  $p = 0.043$ ; *Pearson's* ( $r$ ) = 0.640;  $p = 0.036$ ]. Farmers' risk perceptions of large scale mining as a threat to: community's natural capital; traditional systems; environmental and social protection regime; established administrative procedures and good conducts of public officials; as well as being a threat to rural livelihood have serious implications for achieving the goals of sustainable mining in Ghana. Nonetheless, farmers associated mining as agent of economic development, and education significantly influenced this assessment [*Pearson's* ( $X^2$ ) = 28.093,  $p = 0.021$ ; *Pearson's* ( $r$ ) = 0.077;  $p = 0.041$ ]. This paper concludes that education is a significant predictor in risk perception assessment. Robust environmental and social protection regimes, strong public institutions and improved socio-economic status are good predictors of farmers' risk perceptions of mining.



### Article History

Received: 14 February 2020

Accepted: 15 June 2020

### Keywords

Education;  
Ghana;  
Household Farmers;  
Mining;  
Risk Perception.

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Doi: <http://dx.doi.org/10.12944/CWE.15.Special-Issue1.04>

## Introduction

The importance of research on communities' risk perceptions has been expressed.<sup>1, 2, 3</sup> Studies on risk perception are sufficiently good predictors of communities' attitudes and actions toward development projects.<sup>4</sup> Such studies are also essential in determining whether or not there is potential for community conflict,<sup>5</sup> and thus, help identify how mining companies and communities could co-exist and harness the resource endowment in the catchment area in a sustainable manner.<sup>3</sup> Aubynn<sup>2</sup> and Tufour<sup>6</sup> argued that different users of natural resources perceive and value resources differently; hence, perceptions and values of environmental resources among different users are sources of conflicts. Community risk perception studies, therefore, enable policy makers to identify projects' potential impacts on the host community beforehand, and the need to devise strategies for managing relationships with resource communities.<sup>1</sup>

Within the context of mining and development, studies on community risk perception are important for a number of reasons: 1. Enable researchers and policy makers to establish the linkage between policies governing development projects and perceived risks among local communities, 2. Provide the much needed information and supportive evidence for identifying which resource communities will emerge from or fall into poverty due to the implementation of mineral resources policies, and 3. Promote healthy relationship among stakeholders in resolving issues on economic gains, environmental protection, socio-cultural contestations and land use conflicts.

These notwithstanding, few documented cases - including reported cases in North America, Latin America, Asian Pacific regions and Africa - that relate to communities' risk perceptions of mining<sup>7, 2, 8, 3, 5, 4</sup> could be found. In Africa for instance, relatively fewer studies, including those of Gratz<sup>7</sup> - which discusses gold mining and risk management in Northern Benin; Aubynn,<sup>2</sup> as well as Salami and Tsekor<sup>3</sup> - that investigate communities' perceptions of mining in Ghana, could be accessed. With respect to Ghana, studies relating to communities' risk perceptions of mining are even harder to find. There are virtually no empirical studies that use socio-demographic indicators, particularly education, to analyze how

farming communities perceive or associate risk with large-scale mining projects.

This paper, therefore, seeks to make original contribution to the discussions on mining and impacts on resource-rich farming communities, by deepening understanding of the extent to which education could be used to provide insightful dimensions of how mining is impacting on household farmers in Ghana. The specific objective of this study was to establish the relative influence of education on risk perceptions of large-scale surface mining projects among household farmers in Ghana. To meet this objective, the study attempted to answer the following research questions: (1) How do household farmers, in resource-rich communities, associate risk with large scale mining projects in Ghana? and (2) Does education matter in risk perception assessment? The hypothesis that "*education has no relationship with farmers' risk perceptions of large-scale mining projects in Ghana*" was tested within four thematic areas: Economic Development Perspectives, Environment and Resource Protection Concerns, Institutional and Regulatory Matters, and Socio-cultural Dimensions. These four themes were analyzed within the context of three schools of thoughts: Institutional theory, Regulatory theory and Cultural theory.

To the best of author's knowledge, the above research questions and hypothesis have not been addressed by previous researchers, and no empirical evidence exist that links farmers' levels of education and risk perceptions of large-scale mining, particularly, within the Ghanaian context. The rest of this paper is structured as follows: Section two provides definitions and concepts of risk and risk perception; Section three reviews social scientific and risk literature, and establishes the relationship between education and risk perceptions; Section four describes the profile of the study area; Section five outlines research methods, data sources and data analysis; Section six presents results and discussions, and Section seven concludes.

## Definitions of Risk and Risk Perception

In risk literature, it has been argued that no definition of risk could be advanced as the correct one<sup>4</sup>; however, Sjöberg<sup>9</sup> argued that risk is all about thoughts, beliefs and constructs. Derby and Keeney<sup>10</sup>

asserted that risk is the possibility that consequences involving mortality, morbidity or injury to members of the public may occur. Morgan<sup>11</sup> conceptualized risk from a technological point of view, and averred that, depending on perception and evaluation of any given risk; human may accept it, attempt to reduce exposure to it or act to mitigate effects of the risk. Brun<sup>12</sup> and Adams<sup>13</sup> contended that risk involves a probability estimate for the happening of a negative event. Risk is explained as a function of natural threat and vulnerability to threat,<sup>14 - 16</sup> or a function of probability and consequences.<sup>17</sup> Comparing two methods of assessing risk, Whittaker,<sup>18</sup> affirmed that risk is the likelihood that an adverse effect will occur. Nonetheless, the Society for Risk Analysis broadly defined risk as the potential for realization of unwanted or adverse consequences to human life, health, property or environment.<sup>19.</sup><sup>20</sup> The Society further argued that the estimation of risk, however, is usually based on the expected value of the conditional probability of the events occurring and the consequences of the event, given that it has occurred. Relating adverse effects to hazardous substance exposure, risk is defined as the likelihood that the toxic properties of a substance will be produced in a population of individuals under their actual conditions of exposure.<sup>21</sup> In this study, however, household farmers in resource-rich communities view risk from institutional, regulatory and socio-cultural perspectives. They believe that resource-rich farming communities risk giving social license to large scale mining companies to operate in their community. In their views, large scale mining companies have economic and political power of influence, and may make the very traditional system, public institutions and environmental regulations established to protect the interest and wellbeing of the indigenes non effective.

On the other hand, risk perception is endogenous, and thus, relates to cognitive skill and preferences.<sup>19</sup> It is a clear reflection of real risk, especially, when risks are well known.<sup>20</sup> Risk perception has a substantial influence on decision making and behaviors.<sup>22</sup> From a public policy perspective, risk perception is defined as public's estimate of the possibility of suffering harm or loss from environmental policies and actions.<sup>23, 24</sup> In this current study, risk perception of mining is explain as "The awareness or understanding that a large scale

mine project would cause harm and/or suffering to the communities within the catchment of mining operations, by making them: become vulnerable to poverty and diseases; lose relationships and social networks; lose rights to landholding (surface rights) and tenure security; lose productive land for agricultural activities; lose cultural heritage and community identity; lose income and opportunities (to invest, to educate children, to access bank loan, to improve quality of life and to participate in decision making processes), due to economic and political power of influence by the mining company, which renders environmental laws, regulations, policies, administrative procedures as well as institutional controls and actions non effective".

### Education and Risk Perception

Steele *et al.*,<sup>25</sup> argued that socio-demographic factors are a salient feature of research concerning environmental values, and the most common measures of significant predictions are gender, age and education. Piper and Martin<sup>26</sup> asserted that socio-demographic variables are significant predictors in the valuation of non-market goods. Studies on socio-demographic factors (age, gender and education) have also informed national dialogue on poverty in many parts of the world, including the United States of America, raising the prospect of important variation in the dynamics of family poverty and public policy concerns.<sup>27 - 29</sup>

A notable body of literature has established that certain socio-demographic characteristics do not only put individuals at risk,<sup>30, 31</sup> but also influence positive and negative decisions outcomes.<sup>32 - 36</sup> Socio-demographic characteristics influenced individual's ecological perception and behavior.<sup>37 - 38</sup> Knowledge, experience, beliefs and socio-demographic characteristics have strong relationship with perceived risk.<sup>39</sup> Age, gender and education were found to be associated with perception, behavior, knowledge, adoption of agro-forestry practices and new technologies.<sup>40 - 42</sup> Establishing a link between education, risk perception and health outcomes, Pádua *et al.*,<sup>43</sup> reported that, the risk of developing diabetes correlated significantly and negatively with education. These researchers further maintained that, although education plays a role in risk perceptions, its real impact needs further research. Education was found to be associated with

higher risk perceptions of cancer and higher levels of breast cancer anxiety among young women.<sup>44</sup> Additionally, education and risk perceptions significantly influenced people's smoking decisions, as well as prostate and colorectal cancer screening.<sup>19</sup> According to You,<sup>19</sup> education and risk perceptions of cancer informed government disease prevention policies and medical information dissemination. Correlation between education and technological risk has also been established. Effect of education was found to be significant for the variable "negative feelings" towards the acceptance and use of robot device.<sup>45</sup> Heerink<sup>46</sup> noted that education correlated with perceived sociability, and thus, the more educated participants were, the less open they were to perceiving the robot as a social entity.

Notwithstanding the aforementioned assertions, there is knowledge gap particularly, on how education influences risk perception of large-scale mining projects among resource-rich farming communities in Ghana. While a significant body of knowledge exists on mining in general, the author is yet to come across studies that establish the linkage between education and risk perceptions of large-scale surface mining, using small-scale household farmers as unit of analysis. This study gives emphasis on education; this is because, education is an unbiased variable that is easily measured and usually fixed early in life. It is a measure or an indicator often used to reflect the socioeconomic status of households. The attained educational level anticipates or impacts future occupational chances, potential earning (income), access to health care, labor market, value of the future, access to information, preferences, rank, social networks as well as behavior of an individual.<sup>1, 29, 47</sup> Furthermore, education provides better knowledge, access to information, access to material sources, and gives cognitive ability to deal with issues that enable individual households to make inform choices,<sup>41</sup> It is also said that, education is the most effective way to resolve environmental problems.<sup>48</sup> The strength of this work, therefore, lies in establishing the influence of farmers' levels of education on their risk perceptions of large-scale surface mining projects in Ghana.

### **Profile of the Study Area**

The profile of Ghana (in terms of geographical location, population distribution, agro-ecological

zones, agricultural productivity, natural resources endowment, the extractive industry and contributions of various sectors to the Gross Domestic Product) is well documented.<sup>1, 49 - 50</sup>

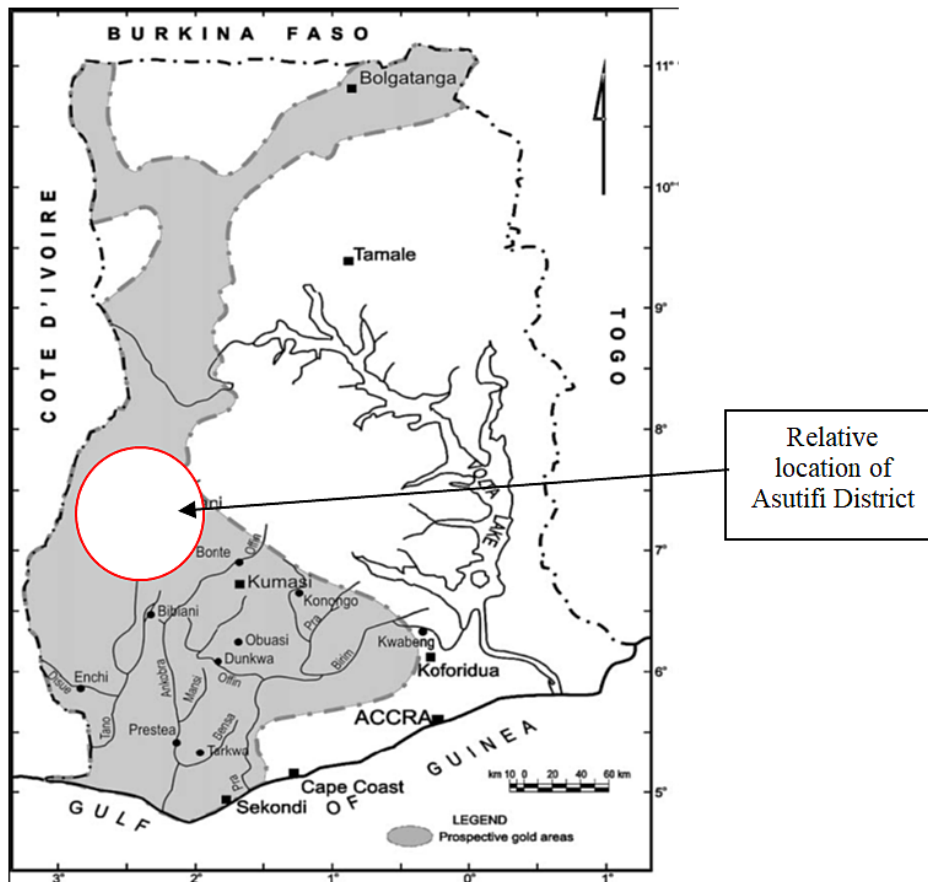
Three farming communities in the Asutifi District (of the former Brong-Ahafo Region) were studied. The district is assuming urban status (that is using 2000 Population and Housing Census criteria of 5,000 as a rural-urban dichotomy), yet it continues to exhibit rural characteristics.<sup>51</sup> By Ministry of Local Government standards, the district is typically rural and deprived, for the following reasons: poor condition of roads; low coverage of electricity; inadequate supply of potable water; subsistence nature of agricultural production, processing and marketing; poor access to extension services; poor market infrastructure; low levels of income; inadequate private sector investment; poor private-public sector dialogue; poor state of social and technical infrastructure; and low absorptive capacity of local communities to take advantage of current economic opportunities.<sup>51</sup>

The suitable climatic conditions have fostered the development and establishment of vast forest reserves in the district, including: the Biaso Shelter Belt, Bia Tam Forest Reserve, Asukese Forest Reserve, Goa Forest Reserve and Desiri Forest Reserve. These reserves together cover about 475.63 square kilometers, constituting approximately 30% of the entire land surface area of the district.<sup>51</sup> The reserves are stocked with timber and non-timber forest products, and the main economic trees are Redwood, Wawa, Odum and Mahogany. The different soil types have high agronomic value for the cultivation of cocoa, coffee, citrus, oil palm and a wide range of staple crops - maize, legumes, cassava, plantain, cocoyam and vegetables.<sup>51</sup> The district has great potential for the cultivation of sugarcane and rice production, and it is known as one of the leading producers of plantain (a semi-perennial food crop) in the nation.<sup>51</sup> Additionally, the district can boast of historic sites and watersheds with many tributaries such as Nsubin, Goa and Ntotro of the Tano River.<sup>51</sup>

The three farming communities studied also form part of the most prominent portions of the precambrian rocks of birimian and dahomeyan

formations.<sup>51</sup> The birimian formations are known to be gold bearing rocks, with high amounts of mineral deposits such as gold, diamond, manganese and bauxite. There are also pockets of granite found over the birimian rocks, which have high potential of iron.<sup>51</sup> Currently, the three farming communities host

one of the largest gold mining companies in Ghana. Thus, these farming communities constitute areas most affected by mining operations within the region. Figure 1 shows prospective gold areas in Ghana and the relative location of the district.



Source: Adopted and modified from Hilson (2002). Shaded area shows prospective gold areas

**Fig 1. Prospective gold areas in Ghana showing the relative location of the Asutifi District**

**Methodology**

Two main research methods (desktop and field studies) were employed in this study. Desktop studies involved a systematic review and analysis of published literature. The materials used in this study included reports, academic articles, peer review journals, scientific papers and textbooks. Articles were identified by following up on references and scrutinizing the publication lists of some online publishers. Major web resources found useful in

this study include: Google Scholar, Science Direct, Springer-Verlag, Web of Science (ISI Web of Knowledge), Discover, Sage publication, FirstSearch and ProQuest. The FAOSTAT home page, the web page of Ghana Chamber of Mines, extracts from reports of local and international NGOs, local newspapers as well as international magazines were also valuable sources of information for this study. Additional data sources that were used are referenced accordingly.

Field studies involved interviews, focus group discussions and house-to-house survey with the use of self-administered questionnaire. Three farming communities within the catchment of large – scale surface mining operations were surveyed. The main house-to-house survey was used as the primary method whereas focus groups and interviews served in a preliminary capacity.<sup>52 - 55</sup> A total of 50 households from each of the three farming communities were sampled for pre-testing studies. The house-to-house (pre-testing) survey exercise was conducted concurrently with focus group meetings and in-depth interviews. The questionnaire was reviewed and some aspects refined before the main house-to-house survey exercise.

A systematic random sampling technique was employed for the house-to-house survey. The main survey was conducted twelve months after the pre-testing exercise. The questionnaire was designed to cover the four major thematic areas mentioned under section 1 (introduction) with a range of specific variables relating to farmers' risk perception of large-scale mining. The main part of the questionnaire composed of closed questions and statements. However, some of the questions or statements were reformulated on the basis of the qualitative data obtained from focus group discussions and exclusive interviews.

Household Heads (HHs) whose primary occupation were or used to be subsistence farming were studied. A total of nine hundred (900) questionnaires were self-administered, that is three hundred (300) household heads were targeted from each farming community. Seven hundred and twenty-five (725) HHs completed their questionnaires, giving a respondent rate of 80.5 percent. Among the HHs surveyed, 64.7% were men and 35.3% constituted women. Twelve group meetings (four from each farming community, with a minimum of six participants and maximum of ten people per group meetings) were held. The focus groups were formed in accordance with guidelines traditionally followed in social science research.<sup>56</sup> The composition of groups varied: one of the twelve groups consisted only of youth (males and females mixed); three groups involved only female adults; three groups also consisted of only male adults; and five groups made

up of adults and the elderly (males and females mixed). Consistency in age was maintained within groups; however, age diversity across groups was established to ascertain the viewpoints of a broad cross section of participants.

Data from interview and focus group discussions were recorded (audio taped) and transcribed with field notes. Data sources were organized around themes and a combination of descriptive, normative and explanatory approach were used in analyzing data collected. House-to-house survey data was categorized into descriptive, behavioral and attitudinal components for analytical purposes. For the descriptive aspect (which included age, gender, education), data was analyzed using descriptive statistical approach - measure of central tendency, dispersion and frequency distribution tables. The distribution of farmers' educational attainment in both pre-testing and the main house-to-house surveys were compared using t-Test. This analysis was needed to determine the properties of the distribution, and to make an inference on how stable and reliable the population has been (in terms of respondents' educational characteristics) between the two sampling time intervals. Additionally, the t-test analysis was performed to ascertain if the sample size for the pre-testing (n=150) was sufficiently large relative to the sample size for the main house –to-house survey (n = 750). Percentage distributions of farmers' responses to the set of questions on behavioral patterns (livelihood patterns, investment potentials, etc.); attitudinal patterns (opinions, perceptions etc.); and results of the focus group meetings were analyzed using Scaled Frequency Distribution Method - Likert Scale.<sup>57, 58</sup> To analyze relationships between variables, survey data was cross tabulated using contingency tables.

To test the reliability and internal consistency of data, *Internal Consistency Indexing and Cronbach's* alpha values were determined. Test of statistical significance (*Pearson's Chi-square– X<sup>2</sup>*) was used to test the statistical validity of perceived differences that existed between variables. Measure of trends and relationships, using *Pearson's Correlation (r)*, were performed to verify the existence and strength of any apparent relationship between variables. Level of confidence was determined at 95% (p-value of 0.05). All comparisons were made

by using parametric or non-parametric tests with two tailed formulation. Computer software package used in aiding the analysis of data was SPSS software. Finally, research findings are composed largely of figures and tables, accompanied by written description, narratives from the exclusive interviews and explanations of the tabular results.

## Results and Discussion

### Demographic Characteristics of Household Farmers in the Three Farming Communities

Almost equal numbers of respondents from each of the three farming communities participated in

the study ( $C_i$ :  $n = 240$ ;  $C_{ii}$ :  $n = 246$ ;  $C_{iii}$ :  $n = 239$ ). Percentage of men who participated in this study was numerically higher than that of women in all the three communities. This probably suggests that the farming communities are mostly dominated by male-headed households. The average family size of a typical household farmer was seven (7). Distribution of farmers' levels of education in all the three farming communities is presented in Table 1.

**Table.1: Distribution of educational attainment of household head farmers in the three farming communities**

Educational Characteristics by Gender		No Formal Education (NFE)	Primary Education (PE)	Middle / Elementary School (MS)	Junior Secondary Education (JSS)	Senior Secondary Education (SSE)	Total
Survey I (Pre-testing study) N = 150	Percentage male respondents (%)	30.11	3.23	39.78	4.3	22.58	100
	Percentage female respondents (%)	57.89	15.79	14.04	8.77	3.51	100
Survey II (Main survey) N = 725	Percentage male respondents (%)	31.84	5.98	37.82	5.13	19.23	100
	Percentage female respondents (%)	60.4	14.18	15.95	7.17	2.3	100

Note: N = sample size

Comparatively, educational attainment was remarkably higher among men than women. The difference in levels of education between males who participated in the pre-testing studies and that of the main house-to-house survey was statistically insignificant [T-test:  $t = 2.306$ ,  $df = 4$ ,  $p = 0.10$ ]. Similarly, levels of education between females who took part in the pre-testing studies and that of the main house-to-house survey did not differ significantly [T-test:  $t = 2.776$ ,  $df = 4$ ,  $p = 0.12$ ]. This suggests that farmers' educational characteristics appeared stable over the two sampling periods (pre-testing and the main surveys).

### Education and Risk Perceptions of Mining: Economic Development Perspectives

Over the past three decades, many governments in developing countries have executed major economic structural reforms and reformulated mineral development policies to attract financial incentives and foreign investors. By the end of 2004, the World Bank alone, had provided US\$ 3 billion in financing twenty-two mining sector reform projects in sixteen developing countries, and more than ninety (mainly developing countries) have redrafted their mineral codes in order to attract outside investment.<sup>59</sup> The influx of foreign investment

has facilitated unprecedented increase in mineral production throughout sub-Saharan Africa, Asia and Latin America.<sup>60</sup>

Ghana has witnessed tremendous inflows of investment into the mining sector over the past three decades. More than US \$2 billion was invested in the sector between 1985 and 1996.<sup>61</sup> During this period, the mining sector was the second largest foreign exchange earner, representing 20% of the country's foreign exchange earnings. By the end of 1996, foreign direct investment (FDI) increased by 12%, out of which 80% went to the gold mining sector. Gold became the predominant mineral produced in the country, accounting for approximately 80% of all mineral revenues with an annual income of US \$600 million.<sup>62-64</sup> By the end of 2002, the mining industry was by far the largest foreign exchange earner, accounting for over 40% of the nation's export earnings. Ghana has become the most significant gold-producing country in West Africa, accounting for about 70% of regional output.<sup>65</sup> The country is also the second leading gold producer in Africa after South Africa, and ranked 10th in terms of world production of gold - producing about 10% of the world's gold.<sup>65, 66</sup>

Currently, the minerals and mining sector is the leading source of direct domestic revenue to the Ghana Revenue Authority (GRA). In 2017, the total fiscal receipts received by GRA from large – scale mining was GH¢ 2.16 billion. This is 16.3 percent increase compared to the GH¢ 1.65 billion received by the Authority in 2016. Income taxes and royalties received by the Authority in 2017 consisted of: GH¢ 969.6 million in corporate income tax, GH¢ 702.4 million in royalties and GH¢ 487.9 million in employees' pay-as-you-earn income tax.<sup>67</sup> The increase in revenue was due to an 11 percent increase in gold production from large-scale mining firms; that is, from a production of 2.54 ounces in 2016 to 2.81 million ounces in 2017.

Data from the Bank of Ghana (BoG) also indicates that, proceeds from export of minerals increased by 19 percent; that is, from US\$5,060 million in 2016 to US\$6,004 million in 2017.<sup>67</sup> Gold exports alone accounted for 96 percent of this amount (US\$6,004 million). The mining industry's share of Ghana's total merchandise export revenues was 43 percent

in 2017. This is more than both the cocoa and crude oil export revenues, which accounted for 19 percent and 23 percent, respectively. By implication, gold export earnings alone were more than the earnings received from cocoa and oil combined. This makes the mining industry, by far, the most important contributor to Ghana's gross international reserves, sustaining the relative stability of the nation's currency (the cedi) on the foreign exchange market.

It is, therefore, contended that without the contributions of Ghana's mining industry to the country's economic fortunes, the government's budgetary expenditure would be reduced by 17 percent annually, this would affect the Cedi - US dollar exchange rate, and increase price levels in the economy by 20 percent than the current level of per capita incomes.<sup>67</sup>

Notwithstanding the economic prosperity associated with large scale mining, the questions this study sought to investigate were: *how do household farmers in resource-rich communities associate risk with large scale mining projects in Ghana, and does education matter in risk perception assessment?* The premise is that, in Ghana, every mineral in its natural state is the property of the Republic of Ghana, and is vested in the President on behalf of and in trust for the people of Ghana. By this legal regime, the Republic of Ghana, and for that matter the President, owns the mineral rights whereas the property land owner or the customary owner has the surface rights. Within the Ghanaian context, a mining concession is an area of land that is delineated for mining purposes. When a mining company is given a concession, the mineral right is conferred to the mining company. The company is given the right to exploit the delimited land area for minerals,<sup>67, 68</sup> and the property land owner loses his/her surface rights. Paradoxically, most farming communities in Ghana are also endowed with mineral resources, particularly gold; and thus, most farming communities are "resource-rich". Many mining concessions are, therefore, cited on lands belonging to customary owners whose livelihoods depend on subsistence farming.

To determine how education influenced farmers' risk perceptions of mining from economic development perspectives, household head farmers were asked to respond to the statement: "*Mining is a*



*high-technology industry that enhances economic development of the nation*", while a lesser proportion of household farmers (27%) with low level of education agreed, 65% and 70% of respondents with medium and high levels of education also agreed, respectively. Difference in perception was statistically significant (Pearson's  $X^2 = 28.093$ ;  $p = 0.021$ ). There was strong association between farmer's risk perception and education (Pearson's  $[r] = 0.077$ ;  $p = 0.041$ ; Table 2). Similar trend in response was observed when farmers were asked to respond to the statement: "*Mining as an industry could be used as a conduit for rural development (i.e. create opportunities to improve quality of life, education,*

*jobs, infrastructure, health facilities, etc)*. Less than half (40%) of the farmers with low level of education agreed, whereas 70% and 85% of respondents with medium and high levels of education agreed to the statement, respectively (Pearson's  $X^2 = 20.375$ ;  $p = 0.035$ ; Pearson's  $[r] = 0.068$ ;  $p = 0.045$ ; Table 2). It could be argued that mining has a positive image among farmers in terms of the industry's economic development potentials. Farmers' responses are consistent with the notion that mining industry is important contributor to Ghana's economic development, and their perception of large-scale mining as agent for economic development, was likely influenced by their levels of education.

**Table 2: Farmers' levels of education and risk perception of mining in relation to economic development**

Perception of mining as industry	Educational attainment (%)			Relationship between risk perception an industry and level of education
	Low level	Medium level	High level	
a. Mining is a high-technology industry that enhances economic growth of the nation (contribute to GDP, source of revenue to the nation, etc.)				
Strongly Disagree	11	14	18	(X <sup>2</sup> ) = 28.093; p = 0.021 Pearson's (r) = 0.770; p = 0.041
Disagree	62	21	12	
Agree	25	50	52	
Strongly Agree	2	15	18	
Do not Know	-	-	-	
b. Mining as an industry could be used as a conduit for rural development (could enhance infrastructural development; create jobs and educational opportunities, etc.)				
Strongly Disagree	4	16	15	(X <sup>2</sup> ) = 20.375; p = 0.035 Pearson's (r) = 0.680; p = 0.044
Disagree	56	14	7	
Agree	32	65	52	
Strongly Agree	8	5	26	
Do not Know	-	-	-	

Note: Low Education = primary school level and below; Medium Education = elementary level and junior secondary; High Education = high school and above.

On the other hand, farmers were asked about their degree of agreement with two statements about large scale mining and rural livelihood. The following statements were formulated during focus groups discussions:

- Mining is a threat to rural livelihood of household farmers in resource – rich communities (a threat to sources of income, property rights, entitlements, opportunities to improve quality of life, and has the ability to make resource communities more vulnerable to poverty).
- Poverty among household farmers in the three farming communities is largely due to the mine project.

The five response categories were: 'Do not know' (coded as 1), 'Strongly disagree' (coded as 2),

'Disagree' (coded as 3), 'Agree' (coded as 4) and 'Strongly agree' (coded as 5). A Livelihood Risk Index based on the average of the responses to the statements for each individual was then constructed (high score = high livelihood risk). Table 3 shows the distribution of farmer's responses and the *Livelihood Risk Index* for both pre-testing and the main surveys. The two statements formed a reliable scale (Cronbach's  $\alpha = 0.754$  and  $0.777$ , respectively in both the pre-testing and the main surveys). Levels of education did not matter when the two statements were oriented to measure the relative influence of education on risk perceptions. For instance, in the case of statement 1 above, at least more than 80% of respondents from all levels of education agreed to the statement, and education had no significant effect on farmers' responses [Pearson's  $(X^2) = 5.221$ ;  $p = 0.990$ ; Pearson's  $(r) = 0.114$ ;  $p = 0.451$ ].

**Table 3: Distribution of farmers' risk perception of mining in relation to rural livelihood (% of Respondents)**

Degree of Agreement	Livelihood Risk Index	Pre-testing	Main Survey
Do not Know	[1; 2]	3	3.6
Strongly Disagree	[2; 3]	3.3	4.4
Disagree	[3; 4]	14.6	12.4
Agree	[4; 5]	49.4	45
Strongly Agree	[5 ]	29.7	34.6
Total		100	100

Note: Livelihood risk index was based on the average of responses to the two statements, each response coded from 1 (Do not know) to 5 (Strongly Agree).

From the result above, it could be contended that mining has a negative image among farmers in relation to the industry's impacts on rural livelihood and poverty. At least more than 80% of respondents from all levels of educational attainment associated mining as a threat to: sources of income, opportunities to improve quality of life, and has the ability to make farmers more vulnerable to poverty. Farmers' responses are consistent with concerns recently raised by a number of government officials including Regional Ministers and the Vice - President of the Republic of Ghana. These officials have publicly accused mining companies of not living up to their fiscal, economic and social obligations, including the development of their host communities.<sup>69, 70</sup>

In 2018, the President of Ghana also remarked on the above concerns when he questioned: *why mining communities in the country are under developed?* He asked this question at the West African Mining and Power Conference and Exhibition held in Accra, Ghana. In his speech, the President quizzed why there is immense difference between South Africa's Johannesburg and Ghana's Obuasi - which for a long time, used to be one of the most endowed gold mines in the world. The President mentioned that the mining industry has failed in having positive impacts on host communities in Ghana.

In responding to the question raised by the President, the mining companies (through the Ghana

Chamber of Mines), contended that successive governments, over the years, have shifted the blame of underdevelopment from the State to the mining companies. The Chamber argued that the government is not using enough of the mining industry's huge fiscal contributions to the State, to develop mining communities in the country.<sup>71</sup> In an instance, the Chamber indicated that, out of the GH ¢ 550 million in royalties that the mining industry paid to the State in 2016, only GH ¢ 27 million was given to the local government authorities that govern mining communities in Ghana. The Chamber further declared that Ghana's mining communities contributed about 45 percent of Ghana's export earnings and 16 percent of direct domestic tax revenues earned in 2017. The Ghana Manganese Company Limited (GMC) alone invested USD \$ 1.3 million in 2017. GMC also made statutory payments (including royalties and taxes) to the tune of USD \$ 16.9 million to the government in 2017. Gold Fields, the biggest gold producing company in the country, and for that matter, the biggest single corporate contributor to the country's fiscal revenues, paid USD \$1.23 billion in corporate tax and royalties in 2017. Additionally, the Company (Gold Fields) paid US\$219.6 million in dividends to the government in that same year. Through its foundation, the Gold Fields spent US\$43.7 million on the development of its host communities, demonstrating its role as a responsible corporate citizen.<sup>72</sup> On the other hand, Newmont Ghana (one of the largest large - scale gold mining company in the country), generated USD \$ 536 million of economic value, which was distributed throughout the Ghanaian economy in 2017. Out of that amount, USD \$89.7 million was paid as employee wages and benefits, USD \$ 62.3 million as taxes, USD \$ 35.1 million as government royalties and USD \$4 million in voluntary community investments.<sup>73</sup> The growth in mineral revenue, explained by the Chamber, reflected in the mining industry's share of merchandise exports (43%) in 2017. This increased growth in 2017, exceeded the contributions made by both cocoa and crude oil to the Ghanaian economy in 2017.

The mining companies in Ghana (mostly foreign multinationals), believe they have a commercial contract with the State.<sup>67</sup> They (the companies) pay taxes, royalties and levies on their income, which should be used to pay for the infrastructure and other

development interventions in their host communities. Thus, from the assessment to the Chamber, it is the primary responsibility of the Government to provide the public in general, and the mining communities in particular, the social and economic infrastructure needed for the development of mining communities. Nonetheless, it could be argued that in spite of the fiscal payments made by large-scale miners to the country's economic fortunes, comparing livelihood that large-scale mining provides with livelihood provided by cocoa farming (estimated as 800,000 household farmers in Ghana), the mining industry (just like the emergent oil and gas industry), is much less livelihood promoter than cocoa farming in Ghana.

#### **Education and Risk Perceptions of Mining: Environment and Resource Protection Concerns**

Mining has long been regarded as the backbone of economic development because of its ability to elicit socio-economic change. However, over the past decades, the effects of mining and mineral processing on the environment have been experienced and complained about in many developing nations. Communities affected by mining have increasingly expressed concerns relating to: environmental pollution, destruction of natural resources, the need to safeguard cultural heritage and community identity, ability to participate in decisions making processes, loss of livelihood, rural poverty, loss of property rights (customary land owners losing their surface rights) and inadequate complementation for crops destroyed.<sup>1</sup>

Many scholars have reviewed the impacts of mining from two perspectives: positive attributes and negative image of mining. Some writers are of the view that mining exerts considerable impacts on both the environment and the livelihood of people living within the vicinity of mining operations.<sup>1, 2, 73-79</sup> While some authors believe that impacts from mining could have positive effects: provides employment, good roads, clinics, schools, drinkable sources of water and electricity,<sup>77, 80-82</sup> others argue that mineral extraction could have negative consequences on the rural communities.<sup>83-86</sup> In spite of the positive attributes, the negative impacts of mining could be substantial. The range of landscape modifications that are introduced by mining is extensively discussed.<sup>87</sup> Weisz<sup>87</sup> described such landscape

modifications as “visual intrusions”, and in some cases, “unsightly or even repellent”. Analyzing metal-mining wastes, UNESCAP<sup>88</sup> distinguished between physical pollution and chemical pollution. Physical pollution results from the ingress of particulates into the atmosphere (as dust and aerosols), water or land; whereas chemical pollutants discharge from mining into the environment include mercury, arsenic, cyanide and solid wastes.<sup>88</sup> Warhurst<sup>89</sup> provided a diagrammatic view of mining impacts from three perspectives (processes, wastes and potential hazards), disaggregating the mine-to-metal

process into exploration, extraction and beneficiation stages. He identified emissions from each stage, and explained how these emissions could pose public health threat when released into the environment. Other sources of literature identify a number of negative impacts associated with mining: residential displacement and environmental degradation,<sup>85, 86, 90 – 96</sup> disruption of cultural norms and values,<sup>1</sup> job displacement, unemployment, conflicts, forcible ejection of local farmers from their farmlands, resettlement– related problems, environmental pollution and loss of biodiversity.<sup>3, 6, 76 - 78, 79, 81, 97 - 102</sup>

**Table 4: Levels of education and risk perception of mining in relation to environment and resource protection concerns**

Perception of mining as industry	Educational attainment (%)			Relationship between risk perception an industry and level of education
	Low level	Medium level	High level	
a. Mining (as an industry) is a threat the air quality and natural resources (water, land, forest and non-timber forest products)				
Strongly Disagree	-	-	-	(X <sup>2</sup> ) = 22.361; p = 0.013 Pearson's (r) = 0.812; p = 0.003
Disagree	-	-	-	
Agree	45.0	25.4	5.0	
Strongly Agree	50.0	68.4	90.0	
Do not Know	5.0	6.2	5.0	
b. There was local protest against the mine project partly due to environmental quality and resource protection concerns.				
Strongly Disagree	-	-	-	(X <sup>2</sup> ) = 19.701; p = 0.042 Pearson's (r) = 0.560; p = 0.019
Disagree	10.0	8.2	8.0	
Agree	50.0	72.8	80.0	
Strongly Agree	30.0	17.0	8.0	
Do not Know	10.0	2.0	4.0	

Note: Low Education = primary school level and below; Medium Education = elementary level and junior secondary; High Education = high school and above.

In this current study, respondents were asked series of questions to determine how their levels of education influenced their risk perceptions of mining from environment and resource protection

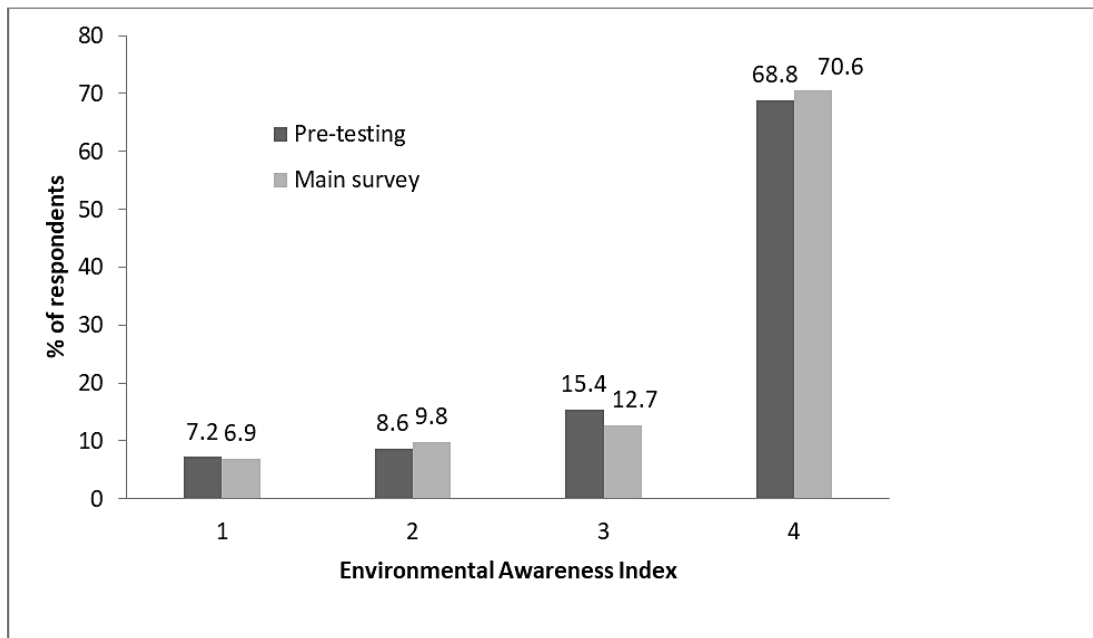
concerns. Participants were asked to respond to the statement: “Mining is a threat to air quality and natural resources (water, land, forest and non-timber forest products)”. Household farmers were to indicate

responses on a five – point scale, from “Strongly Disagree” to “Do Not Know”. Farmers’ responses differed significantly with levels of education [(X<sup>2</sup>) = 22.361; p = 0.013; Pearson's (r) = 0.812; p = 0.003; Table 4]. There is also a statistical evidence to support the claim that local communities protested against the establishment of the mine project partly due to environmental quality and resource protection concerns [(X<sup>2</sup>) = 19.701; p = 0.042; Pearson's (r) = 0.560; p = 0.019; Table 4]. The results from the two statements in Table 4 were obtained from the main survey.

The survey results above are consistent with an exclusive interview granted to an affected (but settled) elderly farmer, Opanin Kwadwo Manu (a made-up name). Opanin Manu was asked to give a narrative of his personal experience in connection with the mine project’s impacts on air quality and natural resources (particularly, water bodies, land, forest and non - timber forest products):

*“I had a five acre mixed crop farm... with my house in the farm. I lived there with my family before the arrival*

*of the mine project... we used to harvest non-timber forest products like mushrooms, snails, fruits, wood for fuel, medicinal plants for the treatment of certain diseases .... we harvested some of the products in commercial quantities which earned us some income.... now we don't have all these opportunities ... emmm...we were about three hundred meters away from the stream down there, it served as source of water for domestic purposes, now..... the stream is polluted... discharges from the mining operations are the main sources of the poor stream water quality,..... . We did not experience dust pollution before the arrival of the mine project... Although the mining company has done well in building good houses (houses constructed with cement blocks and concrete) for us in this new settlement, ....see for yourself, the roads here are not tarred. We are suffering from dust pollution, we inhale dust most part of the day, we cough all the time... can you imagine the amount of dust we would inhale for 25 years before the mine closes down?” ..... emm... we protested against the establishment of the mine project.....but the security people came to intervene”.*

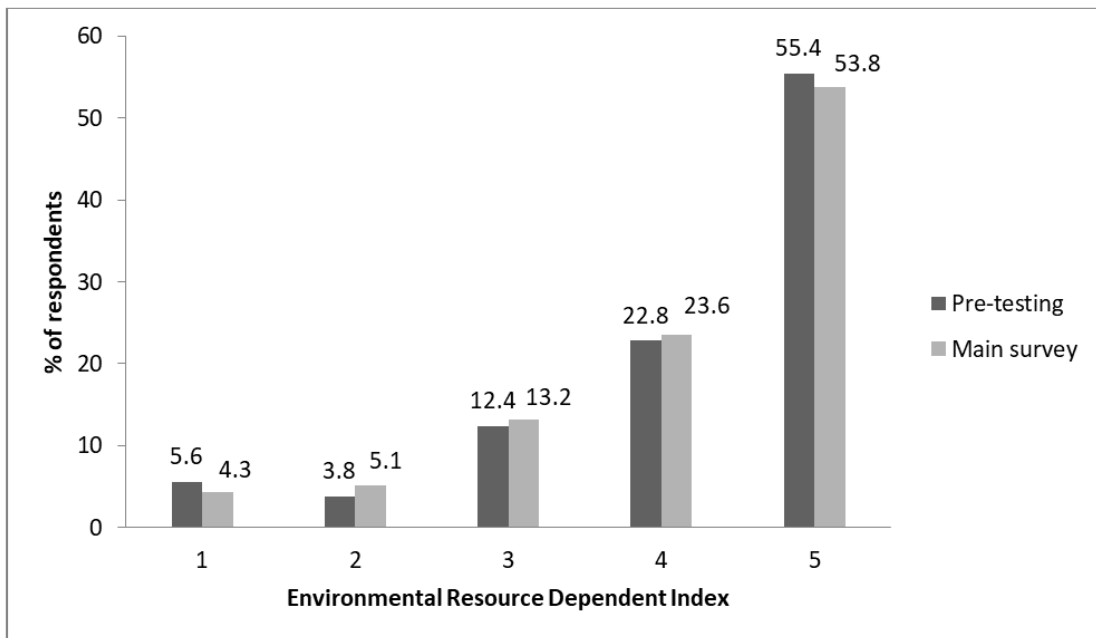


Note: Index of the knowledge of quality of the environment (environmental awareness index) was based on the responses to the statement, “Would you say the quality of the environment and resources in this community were generally good before the arrival of the mine project, how certain are you”? Farmers were to indicate responses on a four-point scale each one coded as: ‘Not at all certain’ (coded as 1), ‘Not very much certain’ (coded 2), ‘Very certain’ (coded 3) and ‘Great deal of certainty’ (coded as 4).

**Fig. 2: Distribution of farmers’ level of knowledge about the quality of environment and resources**

From another dimension, farmers' level of knowledge about the state of the environment and natural resources (before the arrival of the mine project), was assessed using an Environmental Awareness Index. The index summarized answers obtained from the following question: "Would you say the quality of the environment and natural resources in this community were generally good before the arrival of the mine project, how certain are you"? Household farmers were to indicate responses on a four – point scale. The four response categories were: "Not at all certain" (coded as 1), 'Not very much certain' (coded 2), 'Very certain' (coded 3) and 'Great deal of certainty' (coded as 4). The results obtained in Figure 2 were based on focus group discussions. The reliability of the scale formed by the four – point scale was sufficient (Cronbach's  $\alpha$  = 0.732 and 0.751) in the pre-testing study and the main survey, respectively.

The same statement was posed to farmers during the house-to-house survey. This was done to establish the relative influence of education on farmers' level of knowledge about the state of environment before the arrival of the mine project. At least 51.4% of farmers with low educational attainment responded a "Great deal of certainty"; whereas 73.2% and 98.0% of those in the medium and high levels of education respectively, also indicated "Great deal of certainty". Household farmers' levels of education correlated with their knowledge about the state of environment and resources before the arrival of the mine project, and the differences in responses were statistically significant [ $X^2= 26.743$ ;  $p = 0.024$ ; Pearson's ( $r = 0.791$ ;  $p = 0.010$ )]. Thus, the higher the level of education, the greater the likelihood that the household farmer would be more knowledgeable about the state of the environment and resources within their community.



Note: Environmental Resource Dependent Index was based on the responses to the statement: 'Do you agree to the assertion that your livelihood depended on how well the environment and resources were protected in this community, before the arrival of the mine project'? Each response coded as: 'Do not know' (coded as 1), 'Strongly disagree' (coded as 2), 'Disagree' (coded as 3), 'Agree' (coded as 4) and 'Strongly agree' (coded as 5).

**Fig. 3: Distribution of how farmers linked livelihood to environment and resources protection**

To examine how farmers related or linked livelihood to the protection of the environment (particularly, atmospheric conditions) and resources (principally: water bodies, forest, non-timber forest products

and productive land), participants were asked to indicate their responses to the question: 'Do you agree to the assertion that your livelihood (sources of income, opportunities to improve quality of life,

ability to escape from poverty, etc.) depended on how well the environment and resources were protected in this community, before the arrival of the mine project? This question was formulated during focus group discussions. Household farmers were to indicate their responses on a five – point scale, from “Strongly Disagree” to “Do Not Know”. An Environmental Resource Dependent Index was constructed, to measure the extent to which farmers associated their livelihood to the environment and resource protection. As demonstrated in Figure 3, more than half (55.4%) of respondents during pre-testing studies and 53.8% of those who participated during the main survey, responded ‘Strongly Agree’. The internal consistency of the scale was good with Cronbach’s alpha coefficients of 0.759 and 0.778, in the pre-testing and the main surveys, respectively. Moreover, when the same statement was oriented during the main house-to-house survey, to determine the relative influence of education on risk perception, education significantly influenced how farmers linked their livelihood to the environment and resource protection [ $X^2= 25.516$ ,  $p = 0.043$ ; Pearson’s ( $r$ ) = 0.640;  $p = 0.036$ ].

The results above are consistent with the notion that perceived risk deals with the estimate of the possibility of suffering harm or loss from environmental policies, practices and actions.<sup>23</sup> <sup>24</sup>These findings are also in line with the views that mining in resource-dependent communities exerts considerable impacts on both the environment and the livelihood of people living within the vicinity of mining activities.<sup>1, 2, 73</sup> In this study, farmers have negative image of large scale mining, they perceived the mining industry as a threat to environmental quality and natural resources upon which their livelihood depended. They were able to anticipate that the mine project could have substantial adverse effects on the environment, natural resources and their livelihood, and thus, protested before the commencement of the mine project. Farmers’ ability to link their livelihood to protection of the environment and natural resources was significantly influenced by their levels of education. They claimed to have suffered: harm (due to dust pollution and contamination of water bodies within the catchment of the community), and losses (loss of: livelihood, surface rights, productive agricultural lands and

non-timber forest products) due to the mine project. Even though there is positive improvement in the mining sector due to provisions made in the EPA Act 490 of 1994 (including a mandatory Environmental Impact Assessment requirement), deliberate or accidental mining leachates could find their way into water resources and agricultural lands within resource – rich communities. Occasional discharge from secured leachate ponds or from potential pathways (including tailing dams’ failure, mine effluent discharge, seepage, overflow, spray-drift and geotechnical failure) to the environment is unavoidable (especially during wet season), where frequency and duration of overflow is likely to increase.<sup>103-105</sup> Leachates from mineral exploitation could: affect water and atmospheric quality, pose danger to the health of community members and wildlife, result in destruction of farm crops and lead to loss of revenue to the rural people in the affected communities.<sup>1</sup> Major mining related diseases found among resource-rich farming communities in Ghana; include, skin and respiratory diseases as well as acute conjunctivitis.<sup>106, 107</sup> Estimates based on observations and expert opinion also indicate that, the cost of mining impacts to humans, animals, vegetation and water bodies are substantial, and in some cases unquantifiable.<sup>108</sup>

### **Education and Risk Perceptions of Mining: Institutional and Regulatory Matters**

In connection with institutional and regulatory issues, farmers were asked to respond to the following house-to-house survey question: “*Would you say the administrative procedures and conducts of some government officials have worsened the socio-economic status of household farmers in this community*”? Household farmers were to indicate responses on a four – point scale, from “Do Not Know” to “A Great Deal”. While 60% of farmers with low level of education responded “A Great Deal”, slightly over 78% and 90% of respondents in the medium and high educational attainment, respectively, responded same. There is significant relationship between education and risk perception of mining in relation to administrative procedures and conducts of some government officials [ $(X^2) = 19.74$ ;  $p = 0.043$ ; Pearson’s ( $r$ ) = 0.657;  $p = 0.035$ ; Table 5].

**Table 5: Level of education and farmers' risk perception of mining in relation to institutional matters**

Perception of mining as industry	Educational attainment (%)			Relationship between risk perception an industry and level of education
	Low level	Medium level	High level	
a. Would you say administrative procedures and conducts of some government officials have worsened socio-economic status of household farmers in this community?				
Great Deal	60.0	78.1	90.0	(X <sup>2</sup> )= 19.74; p = 0.043 Pearson's (r) = 0.657; p = 0.0 35
Some extend	30.0	10.0	8.0	
Not at all	10.0	11.9	2.0	
Do not Know	-	-	-	
b. Good and effective institutions are best predictors of improved socio-economic conditions of rural farmers in resource-rich communities:				
Strongly Disagree	-	-	-	(X <sup>2</sup> ) = 24.003; p = 0.032 Pearson's (r) = 0.671; p = 0.04427
Disagree	-	-	-	
Agree	24.7	35.1	4.4	
Strongly Agree	40.2	35.1	88.2	
Do not Know	35.1	35.1	7.4	

Note: Low Education = primary school level and below; Medium Education = elementary level and junior secondary; High Education = high school and above.

Again, participants were asked to indicate their levels of agreement to the following statement: *"Good and effective institutions are best predictors of improved socio-economic conditions of rural farmers in resource-rich communities"*. Farmers were to indicate responses on a five – point scale, from "Do Not Know" to "Strongly Agree". Household farmers' with: Low level = 40.2%; Medium level = 71.5 %; and High level = 88.2%, responded "Strongly Agree". Their responses differed significantly with ranks of education [(X<sup>2</sup>) = 24.003; p = 0.032; Pearson's (r) = 0.671; p = 0.027; Table 5]. This result was also observed during the main house-to-house survey. In another instance, household farmers were asked to express their level of agreement to the following two statements that were probed during focus groups discussions:

- Laws, regulations, policies and practices (that relate to mining, environmental and social protection in the country) are weak, and could not offer adequate protection to the environment, properties and interest of household farmers due to political and economic power of influence of the mining company.
- Public institutions (that relate to mining, environmental and social protection in the country) are not strong enough to protect the environment, properties and interest of household farmers due to political and economic power of influence of the mining company.

The five - point response scale were: 'Do not know' (coded as 1), 'Strongly disagree' (coded as 2), 'Disagree' (coded as 3), 'Agree' (coded as 4) and



'Strongly agree' (coded as 5). An Environmental and Social Protection Risk Index based on the average of the responses to the statements for each individual was then constructed (High Score = High Environmental and Social Protection Risk). Table 6 shows the distribution of the Environmental

and Social Protection Risk Index in both pre-testing and the main surveys. The two statements formed a reliable scale (Cronbach's  $\alpha = 0.808$  and  $0.794$ ) respectively, in both the pre-testing and the main surveys.

**Table 6: Distribution of farmers' risk perception of mining in relation to public institutions and regulatory matters**

Degree of agreement	Environmental and Social Protection Risk Index	Pre-testing (% of respondents)	Actual survey (% of respondents)
Do not Know	[1; 2]	6.6	5.7
Strongly Disagree	[2; 3]	7.2	6.5
Disagree	[3; 4]	8.8	9.5
Agree	[4; 5]	26.6	29.4
Strongly Agree	[5 ]	50.8	48.9
Total	100	100	

Note: Environmental and Social Protection Regime here encompasses public or government environmental and allied institutions, laws, regulations and policies that regulate mining and provide social interventions for affected farmers in resource-rich communities.

A narrative, given by an affected household farmer - Opanin Barnieh (made-up name), during an exclusive interview, is consistent with the results from the house-to-house survey and the focus group discussions above. As expressed by Opanin Barnieh, *"we heard that during one of the meetings between some government officials and the management of the mining company, to discuss the compensation package for the affected farmers.... some of the government officials argued that we were living in mud houses before the arrival of the mine... so, the cement blockhouses built for the affected farmers should not have ceiling ... and that, if an affected farmer had six rooms in his/her mud house, the number of rooms should be reduced to three...can you imagine this.....our own people...government officials saying this?.... instead of negotiating a better deal for us ..... "*

From another perspective, respondents were asked about their degree of agreement with two statements centered on traditional institutions and customary laws. The following statements were formulated during focus groups discussions:

- Traditional authorities in this community failed to protect the interest and properties of household farmers due to political and economic power of influence of the mining company.
- Customary laws and land tenure system in this community are weak and ineffective, thus, could not protect the interest and properties of household farmers.

Again, the five response categories were "Strongly Agree" (coded as 5), "Agree" (coded as 4), "Disagree" (coded as 3), "Strongly Disagree" (coded as 2) and "Do Not Know" (coded as 1). Traditional Regime Failure Index based on the average of the responses to the two statements was then constructed [High Score = High Traditional Regime Failure, which implies that traditional institutions and customary laws completely failed to protect farmers' properties and interest]. As illustrated in Table 7; 43.5% of respondents during pre-testing studies and 40.7% of those who participated during the main survey responded 'Strongly Agree'. The internal consistency of the scale is acceptable with Cronbach's alpha coefficients of 0.839 and 0.825, respectively.

**Table 6: Distribution of farmers' risk perception of mining in relation to traditional institutions and customary laws (% of Respondents)**

Degree of agreement	Traditional Regime Failure Index	Pre-testing	Main survey
Do not Know	[1; 2]	6.6	3.8
Strongly Disagree	[2; 3]	6.9	7.7
Disagree	[3; 4]	16.8	18.5
Agree	[4; 5]	26.2	29.3
Strongly Agree	[5 ]	43.5	40.7
Total	100	100	

Note: An index of institutional and customary law failure (traditional systems failure index) was based on the average of responses to the two statements above, each response coded from 1 (Do not know) to 5 (Strongly Agree).

During focus group meetings, majority of household farmers felt government institutions failed to promote communities' concerns and protect properties. Traditional leaders did not have good image in the minds of farmers, and thus, they were perceived as 'not helpful'. A sizeable number of participants (80%) believed that the mining company influenced some government officials and traditional leaders with money, to reduce the sizes of farmlands of the affected farmers, in order to save the company from paying the required compensation for the crops destroyed. Again, some respondents revealed that most members of the review committee on compensation (The Crop Review Committee) were outsiders who did not seek the interest of the affected people.

In Ghana, the traditional chieftaincy system operates alongside a modern local government system (the District Assemblies). Chiefs do not have any prescribed role under the local government system, however, they serve to protect community interests and have been very effective in some cases. (109) The religious-secular nature and compliance roles of traditional authorities confer in them great respect and honor; and in some cases, they are seen as super natural beings. (109) Thus, their influence will continue to be felt since their behavior and practices, governed by traditions and rituals, demonstrate the authority they exercise. In the case of the three farming communities studied, a majority of household farmers reported that the

traditional authorities, some government officials and government institutions failed to protect the environment, properties, interest and livelihood of the local people.

The findings above are consistent with Institutional Theory. The premise of this theory is that, what actors do are guided and shaped by formal rules, compliance procedures and operating standards established by institutions.<sup>110, 111</sup> Institutions have a range of measures and set of rules to streamline activities. The rules set by institutions define acceptable behavior, prescribe appropriate actions, reward good practices, offer sanctions for any possible defection, and provide tools for joint or collective action.<sup>64, 111, 112</sup> Institutions also create expectations of actions for all participants with a certain normative power, which makes defection from the agreed principles and rules of behavior costly.<sup>64, 111, 112</sup> Additionally, institutions provide information and framework of reference to guide future behaviors and practices. Societies or communities with weak institutions lack the ability to curb the excesses of externalities as well as personal and parochial desires.<sup>111, 112</sup> Without strong institutions, a society or community lacks the capacity to create public interests, and for that matter, the means to define and realize its common interests. Highly institutionalized society governed by procedures is more likely to articulate and achieve its public interests.<sup>111, 112</sup> This paper argues that institutions do matter, when assessing communities' risk perceptions of large scale mining. The attitude

of mining firms will depend on the strength of the environmental regime (environmental institutions, laws, regulations, policies and practices) of the country.

Insufficient logistics, inadequate personnel and budgetary concerns were observed (during field visits) as some of the outstanding constraints that impair regulatory institutions from carrying out effective monitoring and enforcing compliance. Agbosu *et al.*,<sup>113</sup> observed that, in Ghana, operations and functions of institutions that relate to mining and environment exhibit serious shortcomings in terms of the capacity to protect and manage the wide range of interests of local people. However, Silverman<sup>114</sup> explained that resources are limited; therefore, environmental regulatory agencies need to establish priorities, develop compliance, monitoring and enforcement response policies. Russell<sup>115</sup> on the other hand, noted that government monitoring activities are often quite limited, and even where firms were not complying, fines imposed by government in ensuring compliance were too low to ensure compliance. In Ghana, EPA, the Mines Department and the Ghana Chamber of Mines play a very minimal role in monitoring and enforcing mining regulations.<sup>116</sup> The performance of most mining companies, with regard to environmental management, depends mostly on goodwill and not on the direct control and enforcement by regulatory agencies.<sup>116</sup>

This paper argues that institutional failure calls for local and informal institutional action. Youth associations, watchdog committees and other social groups could play important roles in bringing about sound environmental management and improved quality of life among household farmers in resource-rich communities. Informal community pressure, street protests and social sanctions (also known as non-economic environmental compliance) could serve as effective tools in ensuring environmental compliance.<sup>117 - 119</sup> Nonetheless, the ability of communities to play compliance roles would depend on the community's levels of income and education.<sup>120</sup>

Another school of thought found relevant in explaining farmers' risk perception of mining is the Regulatory Theory. This theory uses development

model and explains that, societies undergo transformational stages during development: (i) regimes of accumulation stage (characterized by exploitation, consumption of resources, production of goods and services); (ii) modes of regulation stage (characterized by the establishment of norms, conventions, conducts, organizational reforms and institutional rules to stabilize accumulation regime); and (iii) state intervention in the management of accumulation.<sup>121 - 123</sup> The theory advocates the use of environmental regulation and state-based administrative approach in regulating three major resources - air, water and land,<sup>123, 124</sup> which constitute the environment.

The regulatory theory advocates the setting of science-based standards and procedures, and determines individual role as well as collective behaviors for the type and quantities of materials discharged into the environment.<sup>123, 124</sup> The regulatory approach reinforces State's authority to protect public interest and offset some of the political and economic tensions arising from resource exploitation and associated environmental costs onto society.<sup>59</sup> Proponents of this theory view regulation as a dynamic process, giving emphasis on the role of the State, political actors in resource management and environmental regulation.<sup>123, 123</sup> Thus, how the State and political actors regulate the environment, promote community interest, protect natural resources, livelihood and properties of the affected household farmers (within the catchment of large scale mining operations), are theoretical issues this paper investigated.

#### **Education and Risk Perceptions of Mining: Socio-Cultural Dimensions**

A series of statements were posed to investigate farmers' risk perceptions of mining in relation to socio-cultural settings of their communities. Participants were asked about their degree of agreement with the following four statements:

- The mine project has adversely affected peoples' way of life.
- Mining is a threat to cultural norms, beliefs, values and traditional institution.
- Mining companies are not trustworthy in social relations.

- There was local protest against the company due to violation of cultural norms and values. farmers' responses were "Strongly agree" (coded as 5), "Agree" (coded as 4), "Disagree" (coded as 3), "Strongly disagree" (coded as 2) and "Do Not Know" (coded as 1). Table 8 below illustrates the distribution of farmers' risk perception of mining in relation to socio-cultural concerns.

The four statements above were presented to farmers during focus groups discussions. Once more, a five-point scale that guided household

**Table 8: Farmers' risk perception of mining in relation to socio-cultural setting**

Risk perception of mining		Strongly Agree	Disagree	Strongly Disagree	Donot Know	
<b>Pre-testing study</b>						
Distribution of agreements (% of respondents)	Mining has adversely affected peoples' way of life	69.79	19.79	5.21	3.13	2.08
	Mining is a threat to cultural norms, values, beliefs and traditional institution	51.04	32.29	9.38	5.21	2.08
	Mining companies are not trust-worthy in social relations	39.46	50.08	4.21	2.08	4.17
	There was local protest against the company due to violation of cultural norms and values	36.46	45.83	6.25	3.13	8.33
<b>Main Survey</b>						
Distribution of agreements (% of respondents)	Mining has adversely affected peoples' way of life	71.88	21.88	3.12	2.08	1.04
	Mining is a threat to cultural norms, values, beliefs and traditional institution	53.13	34.38	7.29	3.18	2.02
	Mining companies are not trustworthy in social relations	38.54	51.04	3.13	1.04	6.25
	There was local protest against the mining company due to violation of cultural norms and values	37.5	46.88	4.16	1.04	10.42

Note: Peoples' way of life here means how they live, work, interact with one another, their health and general well-being. Not trustworthy in social relations here implies that the mining company did not: honor promises, respect views or concerns of local people, and did not meet the expectations of the local people.

When participants were asked to respond to the statement, "*Mining is a threat to cultural norms, beliefs, values and traditional institution*" at least more than 80% (83.3% and 87.5%) responded "Agree" during the Pre-testing and the Main survey, respectively. "Strongly Agree" means respondents

strongly associated socio-cultural risk to large scale mining projects. The reliability of the scale formed by the four statements was sufficient (Cronbach's  $\alpha = 0.951$  and  $0.953$ ), respectively. Apparently, there was no statistical evidence to substantiate any correlation between how farmers associated risk with mining

(relative to socio-cultural issues) and their levels of education [Pearson's ( $X^2$ ) = 8.495;  $p$  = 0.581]. Again, during the main house-to-house survey, farmers were asked to respond to the statement: "*There was local protest against the mining company partly due to socio-cultural concerns (desecration of sacred places, violation of practices that had spirit-linked prohibitions, indecent behaviors of mine workers toward community members etc)*", at least more than 80% of participants across all levels of educational attainment agreed to the statement [( $X^2$ ) = 21.567;  $p$  = 0.120]. This paper argues that farmers have negative image toward mining with regard to social and cultural matters. No matter how the questions were presented and regardless of differences in level of education, farmers are more likely to see large scale mining project as a threat to the socio-cultural setting of their community.

Results from the survey studies complement findings from the focus group meetings and interviews. During group meetings and interviews, it became evident that the mining company desecrated sacred places (the burial ground of the queen mother), resulting in a fierce protest by the community. It was also revealed that the company was able to influence traditional authorities and was exempted from certain activities that had spirit-linked prohibitions. For instance, it is prohibited (taboo) by customary rule to carry out farming activities or go to the forest on Tuesdays in the three farming communities. Tuesdays are set aside as sacred for the gods of the land, and thus, an individual (native or stranger) risks his or her life violating this rule. However, the mining company was allowed to perform certain rituals to appease the gods, which enabled the workers of the company to work on Tuesdays. This brought about social conflicts and contempt of traditional authority. The mining company was also described as not being trustworthy, that is: did not honor some of the promises made, did not respect indigenous views and knowledge, and did not meet the expectations of local people.

The results above are consistent with the concept of *Trust in Social Relation and the Cultural Theory*. Social trust is the basic element that binds relationships.<sup>125</sup> This paper posits that among household farmers in resource rich communities, social trust is a social legacy that legitimizes affability

in social relations. It instills confidence and informs social learning, experience and risk perception. Douglas<sup>126</sup> asserted that risk perception is a socially or culturally constructed phenomenon. Mary Douglas's views on risk perception led to the cultural theory, which received support by other scholars.<sup>126, 127</sup> Although cultural theory has been challenged,<sup>7</sup> the theory is still relevant in the discussion of risk perceptions and risk interpretations.<sup>128, 129</sup> The theory explains how people perceive and act upon the world around them.<sup>130, 131</sup> It describes tendencies, dispositions, worldviews and approves the notion that humans are influenced by their surroundings – that is the environment affects cognition, behavior and individual decisions.<sup>130, 131</sup> Advocates of cultural theory contend that it is an influential theory capable of predicting and explaining what kind of people will perceive which potential hazards to be dangerous. Proponents of the theory also argue that perceived risk is closely tied to cultural adherence and social learning.<sup>130, 131</sup> What is perceived as dangerous and how much risk to accept are functions of one's cultural adherence and social learning.<sup>127, 128</sup>

Drawing from this theory, it could be argued that, social and cultural issues are experience-based practices that constitute an integral part of how farming communities associate risk with mining. Local farmers' risk perception of mining would be greatly influenced, when mining projects inflict socio-cultural infractions, undermines cultural settings and community identity. Resource - rich communities will perceive mining business negatively or positively based on their past and social learning experience with mining companies.

### Conclusion

Large-scale mining project has both positive and negative attributes in the minds of rural farmers in the three resource - rich farming communities in Ghana, and education matters in risk perception assessment. Depending on how the issues were presented and farmers' levels of education, either the positive or the negative image of mining dominated. Farmers' educational attainment strongly correlated with their knowledge of the state of the environment and condition of natural resources before the arrival of the mine. There is statistical evidence to support the claim that local communities protested against the establishment of the mine project due to their

ability to anticipate adverse effects of the mining project on environmental quality, natural resources and socio-cultural setting of their communities.

Farmers' levels of education significantly influenced their ability to link their sources of livelihood to environmental quality and resource protection. Household farmers associated risk with mining as a threat to: (a) community's natural capital (forest and non-timber forest products, water bodies, and productive agricultural lands), (b) traditional systems (traditional institutions, governance, land tenure security, customary laws, norms, values, beliefs, spirit-linked prohibitions and community identity), (c) the quality of the environment, (d) the effective functioning of government institutions, laws, regulations and policies that relate to mining, environment and social protection (e) the approved administrative procedures, practices and good conducts of government officials, and (f) rural livelihood (losing sources of income, properties, entitlements and surface rights to their farm lands), resulting in farmers' inability to improve their quality of lives and making them more vulnerable to poverty.

Sustainable development amalgamates economic, environmental and social considerations in development projects to better the lives of the present generation, and ensure that future generations will have adequate resources and opportunities. Apparently, sustainable mining is part of the scope of sustainable development. Both sustainable development and sustainable mining are supported by a set of four pillars (economic, social, environmental and governance), which has been outlined as the guiding principles for

determining the net societal worth derived from development projects.<sup>132, 133</sup> On this premise, it could be contended that, farmer's risk perceptions of mining in Ghana, undermine the efforts being made by the country in achieving the United Nation's Sustainable Development Goals (SDGs), which places human capital at the hub of sustainability and business.<sup>134</sup> Nonetheless, household farmers are likely to associate mining as an agent of economic development.

This paper concludes that education is a significant predictor in risk perception assessment. Robust environmental and social protection regimes, strong public institutions and improved socio-economic status are good predictors of farmers' risk perceptions of mining in Ghana.

#### **Acknowledgements**

I am very thankful to the Ford Foundation International Fellowship Program, under the Institute of International Education (IIE), and the State University of New York College of Environmental Science and Forestry (SUNY-ESF) – Syracuse, for training and supporting my PhD degree programme in USA, which has greatly contributed to the publication of this work.

#### **Funding**

The author(s) received no financial support for the research, authorship, and/or publication of this article.

#### **Conflict of Interest**

The author declares that he has no conflicting interesting in performing or publishing this research.

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