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VULNERABILITY OF RURAL LIVELIHOODS TO THE EFFECTS OF MINING: A CASE STUDY OF AMANSIE WEST DISTRICT OF GHANA

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Abstract

The historical importance of mining in the economic development of Ghana is considerable and well documented with the country being the second most important producer of gold. The study determines the effect of mining on rural livelihoods by considering impact of gold mining on rural households. The study employed both quantitative and qualitative methods to analyse the extent of threat posed by mining and its activities on assets and rural livelihoods. The Livelihood Vulnerability Index results show that social, physical and human capital were vulnerable to the impact of mining whilst natural and financial capital were found to be moderately vulnerable as compared to that of non-mining communities. This means that livelihood resources were exposed to the detrimental impact of mining and its activities, hence making it difficult for livelihood outcomes to be achieved by rural households. Also the propensity score matching results obtained showed that households in mining communities had a better well-being than those of non-mining communities due to the higher cost of living in mining communities. The study therefore recommends that government policies with respect to mining should be directed towards the preservation of the endowed livelihood resources in order to achieve sustainable

livelihoods. Also activities of miners should be well regulated to avoid the destruction of livelihood resources by strengthening regulatory institutions.

Keywords: Mining, livelihood indicators, vulnerability, effects, livelihood outcome, gold, resources

INTRODUCTION

Since the inception of the national Economic Recovery Program (ERP) in 1983, the Ghanaian government, under the guidance of the IMF and World Bank, has amended numerous policies to establish a more attractive investment climate for foreign mineral-exploration and extraction companies. The country's mining industry has since expanded rapidly, experiencing by 2004 a fivefold increase in annual gold output and big rises in bauxite, diamond, and manganese production; however, at the same time, the perpetual expansion of mining and allied activities has strained indigenous communities: some subsistence groups have been displaced outright, and/or have been victimized by excessive mine pollution (Hilson, 2004)

Chambers and Conway (1992) described rural livelihoods as comprising more often several activities. These activities can range from cultivation, herding, hunting, gathering, and reciprocal or wage labour, trading and hawking, artisanal work such as weaving and carving, processing, providing services in transport to fetching and carrying. Nyamekye (1996) pointed out that where mining is practiced, there is the effect of reduction in food production in general that leads to increases in prices of all kinds of foodstuffs, hence the rising cost of living in general.

Tsikata (2007) indicated that the mining sector's importance to the country's economy is not adequately linked with other economic growth-promoting activities. Except for the employment of a semiskilled labor force, most mining sector inputs are imported, whereas the mineral products are exported with little or no value added domestically. In other words, the multiplier effect that could have accelerated growth is lower than would be the case if mining activities were integrated properly into the economy. Another challenge is the social and environmental costs associated with mining. Few of the developmental benefits expected to accompany the exploitation of minerals have materialized in the host communities.

The population in mining areas suffers from such problems as displacement of indigenous communities, loss of livelihoods, and adulteration of local culture, conflicts and human rights abuses, diversion of watercourses, and loss of biodiversity due to the environmental destruction (Akabzaa, Seyire, and Afriyie 2007).

The historical importance of mining in the economic development of Ghana is considerable and well documented with the country being the second most important producer of gold.

Since 1989 when small scale mining in Ghana was legalised, a lot of interest has been generated in the sector because of it's socio-economic benefits. However, owing to lack of the necessary training and inadequate financial base on the part of small scale operators, most operations are poorly managed environmentally (Amegbey et al, 2007).

It has been suggested that a thorough cost/benefit analysis of the resurgent mining sector would probably return a negative figure.

The social organisation of every community is guided by certain principles. For instance the concentration of mining operations in Tarkwa of Ghana has had a seriously adverse impact on the social organisation and cultural values of the people. Concerns have been expressed about inadequate housing, youth unemployment, family disorganisation, school drop-out rates, prostitution and drug abuse.

Adeboye (2012) when studying the effect of mining on farming focused his study on a mining area where perception of respondents on the effect of mining and its consequences on farming were obtained through interviews and analysed using descriptive statistical tools such as frequency and percentage. Adeboye limited his study to only mining area and this does not provide a complete results of the effect of mining since the issue of counterfactual plays important role in intervention studies.

Exploratory studies in the Amansie West District show that arable lands and farms are lost daily in addition to increasing cost of living as a result of the influx of miners and their activities.

Research Questions

Therefore the research seeks to address the following questions:

1. What is the vulnerability of livelihood resources to the impact of mining?
2. How do mining operations affect the outcome of rural livelihoods?

Research Objectives

The major objective of this study is to determine the effect of mining on rural livelihoods in Ghana.

The specific objectives are to:

1. To investigate the extent of vulnerability of livelihood resources to the impact of mining
2. To determine the livelihood outcome of rural households in mining communities

THEORETICAL FRAMEWORK

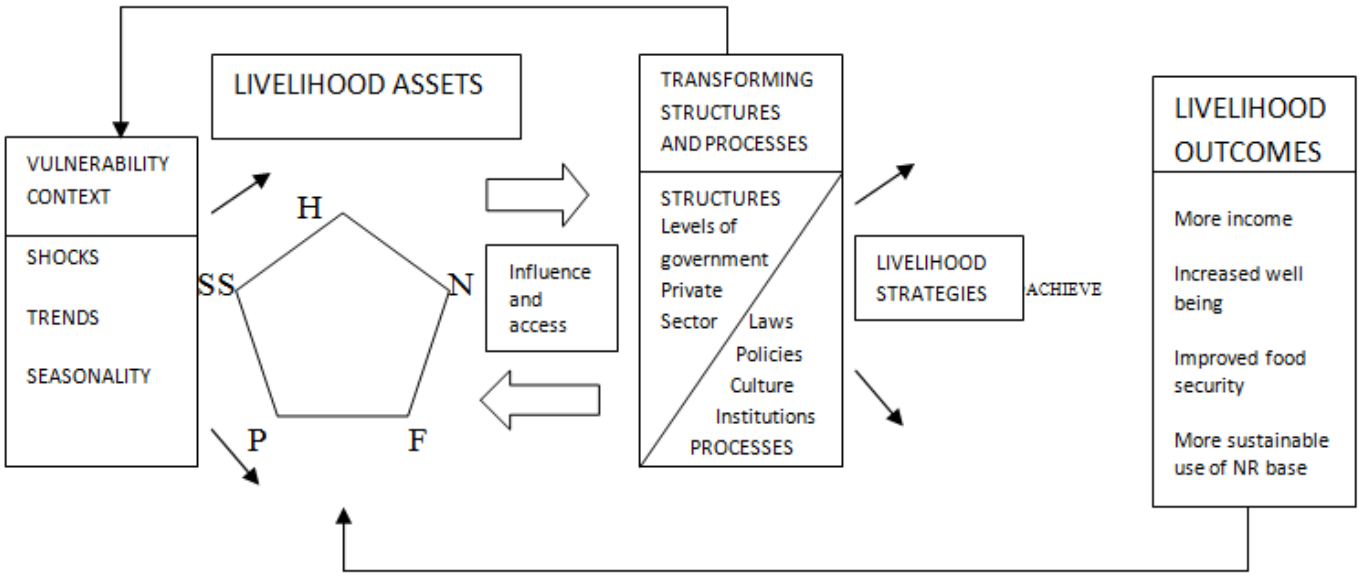
Conceptualizing Livelihood

Different Livelihood Approaches have been developed by different agencies such as DFID, CARE, OXFAM, UNDP. The common thread that unites all the agencies is that they link their ideas back to the work of Chambers and Conway in the early 1990s and most adopt the Chambers and Conway definition of livelihoods (or some slight variant on this). This definition holds that: 'a livelihood comprises the capabilities, assets (stores, resources, claims and access) and activities required for a means of living: a livelihood is sustainable which can cope with and recover from stress and shocks, maintain or enhance its capabilities and assets, and provide sustainable livelihood opportunities for the next generation; and which contributes net benefits to other livelihoods at the local and global levels and in the long and short term' (Carney et al, 1999).

CARE, OXFAM, and UNDP have used sustainable livelihoods models in their programming. While similar in many ways, all models differ slightly in the components of the framework, their emphasis on each part, and the extent to which they implement the framework into their development programs. This study devotes the greatest attention to the DFID model because it was developed recently and incorporates many elements from that of the other agencies and it is one of the most prominent frameworks among the others.

DFID (1999) defined vulnerability context as the external environment of risk in which households or individuals exists and this context includes seasonality (price, production and employment opportunity); trends (national/international, economic trend and technology trend), and shocks (natural disaster, ill health, economic shock, livestock health shock). Information obtained from a pre-survey in the study area indicated that mining has influence on livelihood assets of farmers such as financial (loss income), human (high labour cost), social (cultural values), physical and natural assets (loss of land). The study would concentrate on the most affected assets of farmers to ascertain the main impact of mining on farmers. The threat and influence of mining as well as the coping strategies of farmers in the study area would be analysed. The risk coping is a short-term response to adversity (Roland-Holst *et al.*, 2007a).

Figure 1. DFID'S Sustainable Livelihood Framework



Source: Carney et al, 1999

In the above framework; **H** represents **human capital**: the skills, knowledge, ability to labour and good health important to the ability to pursue different livelihood strategies;

P represents **physical capital**: the basic infrastructure (transport, shelter, water, energy and communications) and the production equipment and means that enable people to pursue livelihoods;

S represents **social capital**: the social resources (networks, membership of groups, relationships of trust, access to wider institutions of society) upon which people draw in pursuit of livelihoods;

F represents **financial capital**: the financial resources which are available to people (whether savings, supplies of credit or regular remittances or pensions) and which provide them with different livelihood options; and

N represents natural capital: the natural resource stocks from which resource flows useful for livelihoods are derived (e.g. land, water, wildlife, biodiversity, environmental resources).

RESEARCH METHODOLOGY

This study identifies and understands the effects of mining on the livelihoods of farmers. The livelihoods framework of DFID (1999) is found to be suitable for this study in order to analyse both impact on the livelihoods and responses in the institutional context. The framework is used as a guide to identify the livelihood indicators in the study area.

Cross-sectional data on farmers in mining communities were obtained and perception of farmers on the influence and threat of mining was sought through questionnaires, focus group discussion and participatory rural appraisal. The data obtained were analysed using descriptive statistics where differences in livelihood indicators between farmers in mining and non-mining communities were verified. Livelihood Vulnerability Index (LVI) was computed to know the extent of vulnerability of rural households' livelihood to mining and its operations. Propensity Score Matching was also adopted to compare households in mining and that of non-mining communities with respect to well being measured as annual expenditure per capita which serves as the livelihood outcome.

Method of Data Analysis

Livelihood Vulnerability Index

The study aimed to calculate the level of vulnerability under impacts of mining and its activities in the Amansie West District by applying the Livelihood Vulnerability Index (LVI) developed by using a balanced weighted approach (Sullivan 2002; Hahn et al. 2009). Each sub-indicator of livelihood assets contributes equally to the overall index even though each major component or major indicator comprises of different numbers of sub-indicators(sub-components). A simple method with equal weights is applied for all major components. Because each sub-component is measured on a specific scale, it is therefore normalized as an index. For this purpose the equation used in the LVI computation is shown below:

$$Index_{sv} = \frac{s_v - s_{min}}{s_{max} - s_{min}} \qquad (1)$$

where, Sv is the value of sub-component for village v; Smin and Smax are the minimum and maximum values, respectively, from data of that sub-component in the study area. After normalizing sub-component values, the value of each major component is calculated by Eq. (2):

$$M_{vj} = \frac{\sum_{i=1}^{n} Index_{sv}}{n} \qquad (2)$$

where, Mvj is value of major component j for village v; $index_{svi}$ represents the value of sub-component s indexed by i of major component Mj; and n is the number of sub-components in major component Mj.

The major component values are directly used in Eq. (3) or aggregated to five values for livelihood assets [H (Human capital), N (Natural capital), S (Social capital), P (Physical capital) and F (Financial capital)] before used in Eq. (4) to obtain the weighted average of LVI:

$$LVI_V = \frac{\sum_{j=1}^{n} w_{MJ}\, M_{vj}}{\sum_{j=1}^{n} w_{Mj}} \qquad (3)$$

$$LVI_V = \frac{w_H H_v + w_N N_v + w_S S_v + w_P P_v + w_F F_v}{w_H + w_N + w_S + w_P + w_F} \qquad (4)$$

Where, LVIv is the livelihood vulnerability index of the study area; is weight value of major component j; wH, wN, wS, wP, wF are weight value of asset H, N, S, P, F, respectively. The LVI is ranged from 0 to 1; 0 denoting least vulnerable and 1 denoting most vulnerable.

Livelihood indicators or sub-components of community vulnerability to mining impacts are grouped into twelve major components presented in Table 1. These components are classified under 5 different livelihood assets of households in the Sustainable Livelihood Framework: Human, Physical, Social, Natural and Financial capitals.

Table 1: Measures of Livelihood Indicators

Capitals	Components	Subcomponents	Description and Measurement
Human	Knowledge and skills	HH without access to farm labour	HHs that have not had labour for 1 year
		HH without access to extension training	Dummy(extension training=1, if not=0)
		Poor educational level	4-Illiterate, 3 Basic, 2-Secondary, 1-Tertiary
	Health	HH reported of death due to mining	Dummy(reportof death=1, if not=0)
		Incidence of malaria within the year	3-Thrice, 2-Twice, 1-Once,0-Nil
	Food	HH with insufficient food	Dummy(Food shortages for more than 5months in year =1,Otherwise=0)
Natural	Land	HH with small farm size(<0.5)	
		HH with no access to land	Land ownership=1, Does not own land=0
		HH with farm size lost to miners	Dummy(lost farm size=1, otherwise=0)
	Water	HH without access to portable water	No. that fetches water to farm for drinking and farm activities
Social	Demography	Female headed HHs	Dummy(Female =1, Male=0)
		HH with high dependants(>10)	Dummy(dependency>10=1, otherwise=0)
		HH without leadership status	HH that have not held any social leadership position
	Network and Relationship	HHs without assistance from any organisation	Dummy(HH without assistance =1,HH with assistance=0)

Table 1...

		Membership of association	Dummy(Membership of association =0,Non-members=1)
Physical	Road	Time to reach District capital	Average time to reach the capital from the communities Maximum time =60mins Minimum=15mins
	Production	HH without access to farm production inputs	Dummy(HH without access to inputs=1, HH with access to inputs=0)
	Housing	HHs with houses without renovation for the past 5 years	Dummy(HH without renovation =1, otherwise=0)
Financial	Assets	Inverse of average land holding index	Hectares
	Finance	HH without access to credit	Dummy(HH without access to credit=1, HH with access to credit=0)
		HH without access to savings	Dummy(HH without access to savings=1, HH with access to savings=0)

Propensity Score Matching

Sianesi(2001) explains the basic steps involved in implementing propensity score matching. He indicated that there should be a data on a binary dummy variable identifying participants and non-participants in this case farmers in mining communities and non-mining communities respectively, the outcome to be evaluated thus annual household expenditure per capita of farmers and a set of covariates. Firstly, the propensity scores are estimated on the covariates using probit or logit and retrieve their predicted values. Secondly, each respondent in a treatment community (mining) is paired with the comparable correspondence in untreated community (non-mining) on the basis of propensity scores. Finally, the counterfactual outcomes of respondents in treated communities are estimated as the weighted outcomes of neighbors in untreated communities. There are several matching methods developed to match respondents in treated communities and that of untreated communities of similar propensity scores. Presumptively, all matching methods should yield the same results. However, in practice, there are trade-offs in terms of bias and efficiency with each method (Caliendo and Kopeinig, 2008). Propensity score matching is a two-step procedure. First, a probability model (logit model) for farmers in treated communities (mining communities) is estimated to calculate the probability (or propensity scores) of the effect of mining for each individual. The coefficients of the logit regression estimate of covariates hypothesized to influence the outcome represent the propensity scores and forms a region of common support about which matching is done. The second step focuses on the matching process. Each farmer in a mining community is matched

to a farmer in a non-mining community with similar propensity score values based on the covariates, in order to estimate the Average Treatment Effect for Treated individuals (ATT) described as the farmers in the mining communities. The difference in ATT and the Average Treatment Effect for Untreated individuals (ATU) described as the farmers in non-mining communities is the Average Treatment Effect (ATE) which is the overall effect of mining on household income of both farmers in the mining communities and farmers in the non-mining communities.

Propensity score matching was used to determine whether mining and its operations are having impacts on the livelihood outcome of farmers in mining communities when compared to that of non-mining communities. The outcome variable used is annual expenditure per capita which measures well being of households in mining and non-mining communities.

The study used annual consumption expenditures level per capita to measure household well-being (livelihood outcome) as used by Lopez (2008) in his study. Household well-being is directly related to livelihood selections. Our well-being measure is, then household consumption expenditures on final goods per capita, where expenditures are broadly defined to include the value of home produced and consumed goods, as well as outflows of money used in consumption. Propensity score matching creates a statistical comparison group by matching every individual observation in mining communities with an observation with similar characteristics from the group of non-mining communities. In essence, matching models create the conditions of an experiment in which farmers from mining and farmers from non-mining communities are randomly assigned, allowing for the identification of individual contributing factor(s) between exposure to mining and outcome variables. The contributing factors are the ones that all available information or evidence identifies as influencing the change in observable outcome thus household annual expenditure per capita.

In this study, the Nearest Neighbour Matching (NNM) was used. The basic approach used in the Nearest Neighbour Matching is to numerically search for “neighbours” of farmers in non-mining communities that have a propensity score that is very close to the propensity score of the farmers in mining communities. Below is the binary logit specification to obtain the propensity score matching;

$$mining = \beta o + \beta_1\, age + \beta_2\, fmlysz + \beta_3\, ms + \beta_4\, yrsedu + \beta_5\, deprat + \beta_6\, \text{farmsz} + \beta_7\, fert + \beta_8\, imseed + \beta_9\, extcnt + \beta_{10}\, train + \beta_{11}\, crdt + \beta_{12}\, leader + \beta_{13}\, coop + \beta_{14}\, lbrcost + \beta_{15}\, gender + ei$$

mining = mining (1 if farmer is in a mining community, 0 otherwise)

Table 2: Variables and description used in the logit model

Variables	Description and measurement
AGE	Age of household head (year)
FMLYSZ	Family size
MS	Marital status
EDUCTN	Formal education of household head (number of years in school)
DEPRAT	Dependent household members measured in number
FARMSZ	Total farm size of household (hectare)
FERT	Application of fertilizer
IMSEED	Dummy variable takes 1 if a household use improved seed, 0 otherwise
EXTCNT	Number of times extension agent visited/advised farmer (number)
TRAIN	Farmer attended formal agricultural training, dummy variable (= 1, if yes; =0, otherwise)
CREDIT	Farmers access to credit, dummy variable (=1, if yes; =0, otherwise)
LEADER	Households participation in local social leadership, dummy variable takes value of 1 if a household participated,
COOP	Households membership in cooperative organization, dummy variable (=1, if yes; =0, otherwise)
LBRCOST	Annual Cost of Labour per ha in Ghana Cedis
GENDER	Male=1, Female=0

Use of expenditure per capita as outcome in the Propensity Score Matching model

According to Lopez (2008), a livelihood strategy represents the composition of activities engaged in by members of the households resulting in outcomes that provide well-being. We use annual consumption expenditures level per capita to measure household well-being study as used by Lopez (2008) in his study. Household well-being is directly related to livelihood selections. For instance, households might be involved in agricultural production or non-farm activities as a livelihood strategy and achieve higher or smaller amounts of well-being as a result of their decision. Diversifying activities is a way to manage variability in outcomes (Winters *et al.* 2001). Income is regarded as the main outcome of analysis for most studies, due to household motivations to diversify such as income maximization, income stabilization or both. However, income is a flawed measure of well-being for a number of reasons. First, it tends to be underestimated because households tend to underreport it for strategic reasons. Second income, particularly in rural areas, is irregular and subject to shocks. It can be a misleading indicator of economic status and earnings are susceptible to temporary fluctuations due to

transitory events. Income may fail to capture disparities in consumption that result from differences across families in the accumulation of assets or savings. For households that face poverty and high extent of material deprivation, income is a poor measure and it is not reliable (Meyer and Sullivan, 2003). Most researchers suggest the use of expenditures as a measure of well-being due to the ability to smooth over short term fluctuations, its relative ease of measurement, and clear interpretation as a well-being outcome (Barret *et al.* 2001). According to the World Bank (2001), consumption is conventionally viewed as the preferred well-being indicator for practical reasons of reliability because consumption is thought to capture long-run well-being levels. Consumption is less vulnerable to under reporting bias and ethnographic effects for poor households with low resources (Meyer and Sullivan, 2003; Ravallion, 2003). Our well-being measure is, then household consumption expenditures on final goods per capita, where expenditures are broadly defined to include the value of home produced and consumed goods, as well as outflows of money used in consumption. That total value is used as a well-being measure of the households. The annual expenditure per capita of household of the respective adopted strategies would be analysed through descriptive statistics to determine which livelihood strategy provides the best well-being and hence reduce vulnerability to mining effects. It is necessary to clarify that only consumption goods would be included in the measure. For example, pesticide or fertilizer expenses would not be included. An important factor to livelihood adoption is the asset base.

Sampling

Simple random sampling was employed to obtain data from household heads in selected mining and non-mining communities. Cross sectional data of farmers in mining and non-mining communities as well as other socio-economic characteristics were collected using semi-structured questionnaire. The sample size was two hundred household selected from ten mining communities and ten non-mining communities. Firstly cluster sampling was used to select mining and non-mining communities after which simple random sampling was used to select households from the farmers data obtained from COCOBOD and MoFA in the study area.

Data Collection

The questionnaires were developed based on the research objectives. The questionnaires contained wide range of question types including closed questions such as dichotomous choice, multiple choice, likert scale agreement level, importance scale and rating scale questions as well as a few open questions mostly intended to elicit further explanation behind choices.

Study Area

The Amansie West District was carved out of the former Amansie District in 1988. The District shares common boundaries with eight districts namely: Atwima Nwabiagya and Atwima Mponuah to the west, Bekwai Municipality, Amansie Central and Obuasi Municipal to the east, Atwima Kwanwoma to the north and Upper Denkyira and Bibiani to the south. The surrounding regions and districts with respect to this location provide opportunity for marketing goods and services from the district. The location of the district makes it the gate way to Ashanti from western and central.

This has a great potential for promoting hospitality industries such as hotels, restaurants and crafts products. With its vast land area, there is access to agricultural land for promotion of rice, citronella, cocoa, oranges and oil palm plantations to feed the local agro based industries and beyond.

RESULTS AND DISCUSSION

Livelihood vulnerability to the effects of mining

The Livelihood Vulnerability Index (LVI) of mining communities is 0.56 which is vulnerable as shown in Table 3. Thus the livelihoods of rural households are vulnerable to the impact of mining and its activities. The capital resources or assets in mining communities are vulnerable to the effect or impact of mining and its activities as compared to that of non-mining communities with LVI 0f 0.35 which was found to be slightly vulnerable as shown in Table 4.

Table 3: Livelihood Vulnerability Index of Livelihood Indicators in Mining Communities

Capitals	Components	Subcomponents	Units	Means	Maximum value	Minimum value	VI
Human	Knowledge and skills	HH without access to farm labour	percentage	53	100	0	0.53
		No access to extension training	percentage	90	100	0	0.9
		Poor educational level	scale	3.04	4	1	0.68
	Knowledge and skills Vulnerability(A)						**0.703**
	Health	HH reported of death due to mining	percentage	21	100	0	0.21
		Incidence of malaria within the year	scale	1.98	3	0	0.66
	Health Vulunerability(B)						**0.435**
	Food	HH with insufficient food	percentage	63	100	0	0.63
	Food Vulnerability(C)						**0.63**
Weighted Average of A,B,C :Human Capital Vulnerability(A1)							**0.6**

Table 2...

Natural	Land	HH with small farm size(<0.5)	Dummy	0.56	1	0	0.56
		HH with no access to land	percentage	61	100	0	0.61
		HH with farm size lost due to miners	percentage	22	100	0	0.22
	Land Vulnerability(D)						**0.46**
	Water	HH without access to portable water	percentage	43	100	0	0.43
	Water Vulnerability(E)						**0.43**
Weighted Average of D,E :Natural Capital Vulnerability(A2)							**0.45**
Social	Demography	Female headed HHs	percentage	39	100	0	0.39
		HH with high dependants dependants(>10)	percentage	62	100	0	0.62
		HH without leadership status	percentage	61	100	0	0.61
	Demographic vulnerability(F)						**0.615**
	Network and Relationship	HHs without assistance from any organisation	percentage	78	100	0	0.78
		HH that do not belong to any group		64	100	0	0.64
	Network and Relationship Vulnerability(G)						**0.71**
Weighted Average of F,G:Social Captital Vulnerability(A3)							**0.66**
Physical	Road	Time to reach District capital	Time(minutes)	55	60	15	0.9
	Road Vulnerability(H)						**0.9**
	Production	HH without access to farm production inputs	percentage	60	100	0	0.6
	Production Vulnerability(I)						**0.6**
	Housing	HHs with houses destroyed by miners	percentage	45	100	0	0.45
	Housing Vulnerability(J)						**0.45**
Weighted Average of H,I,J:Physical Capital Vulnerability(A4)							**0.643**
Financial	Assets	Inverse of average land holding index	Hectre	0.196	1	0	0.196
	Asset Vulnerability(K)						**0.196**
	Finance	HH without access to credit	percentage	72	100	0	0.72
		HH without access to savings	percentage	61	100	0	0.61
	Finance Vulnerability(L)						**0.665**
Weighted Average of K,L:Financial Capital Vulnerability(A5)							**0.43**
LIVELIHOOD VULNERABILITY INDEX 0.56							

Table 4: Livelihood Vulnerability Index of Livelihood Indicators in non-mining community

Capitals	Components	Subcomponents	Means	Observed value	Maximum value	Minimum value	VI
Human	Knowledge and skills	HH without access to farm labour	percentage	14	100	0	0.14
		No access to extension training	percentage	17	100	0	0.17
		Poor educational level	scale	2.2	4	1	0.4
	Knowledge and skills Vulnerability(A)						**0.23**
	Health	HH reported of death due to mining	percentage	0	100	0	0
		Incidence of malaria within the year	scale	0.8	3	0	0.2666
	Health Vulunerability(B)						**0.267**
	Food	HH with insufficient food	percentage	14	100	0	0.14
	Food Vulnerability(C)						**0.14**
Weighted Average of A,B,C :Human Capital Vulnerability(A1)							**0.2**
Natural	Land	HH with small farm size(<0.5)	Dummy	0.25	1	0	0.25
		HH with no access to land	percentage	27	100	0	0.27
		HH with farm size lost due to miners	percentage	0	100	0	0
	Land Vulnerability(D)						**0.173**
	Water	HH without access to portable water	percentage	11	100	0	0.11
	Water Vulnerability(E)						**0.11**
Weighted Average of D,E :Natural Capital Vulnerability(A2)							**0.19**
Social	Demography	Female headed HHs	percentage	27	100	0	0.27
		HH with high dependants (>10)	percentage	45	100	0	0.45
		HH without leadership status	percentage	87	100	0	0.87
	Demographic vulnerability(F)						**0.53**
	Network and Relationship	HHs without assistance from any organisation	percentage	62	100	0	0.62
		HH that do not belong to any group		65	100	0	0.65
	Network and Relationship Vulnerability(G)						**0.64**
Weighted Average of F,G:Social Captital Vulnerability(A3)							**0.58**

Table 4...

Physical	Road	Time to reach District capital	Time(minutes)	47	60	15	0.71
	Road Vulnerability(H)						**0.71**
	Production	HH without access to farm production inputs	percentage	32	100	0	0.32
	Production Vulnerability(I)						**0.32**
	Housing	HHs with houses destroyed by miners	percentage	0	100	0	0
	Housing Vulnerability(J)						**0**
Weighted Average of H,I,J:Physical Capital Vulnerability(A4)							**0.343**
Financial	Assets	Inverse of average land holding index	Hectre	0.186	1	0	0.186
	Asset Vulnerability(K)						**0.186**
	Finance	HH without access to credit	percentage	81	100	0	0.81
		HH without savings	percentage	55	100	0	0.55
	Finance Vulnerability(L)						**0.68**
Weighted Average of K,L:Financial Capital Vulnerability(A5)							**0.43**
LIVELIHOOD VUNERABILITY INDEX: 0.35							

Figure 2: Radar Diagram Showing Vulnerability Index of Livelihood Indicators in Both Mining And Non-Mining Communities

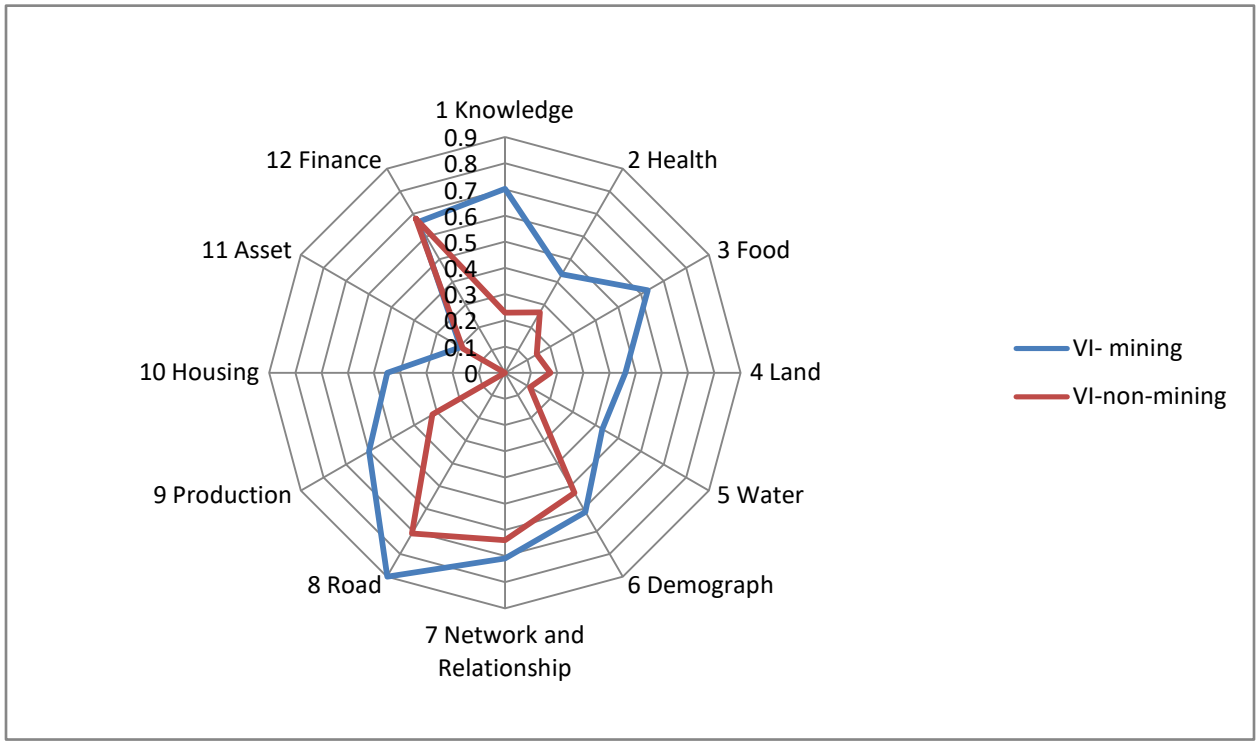
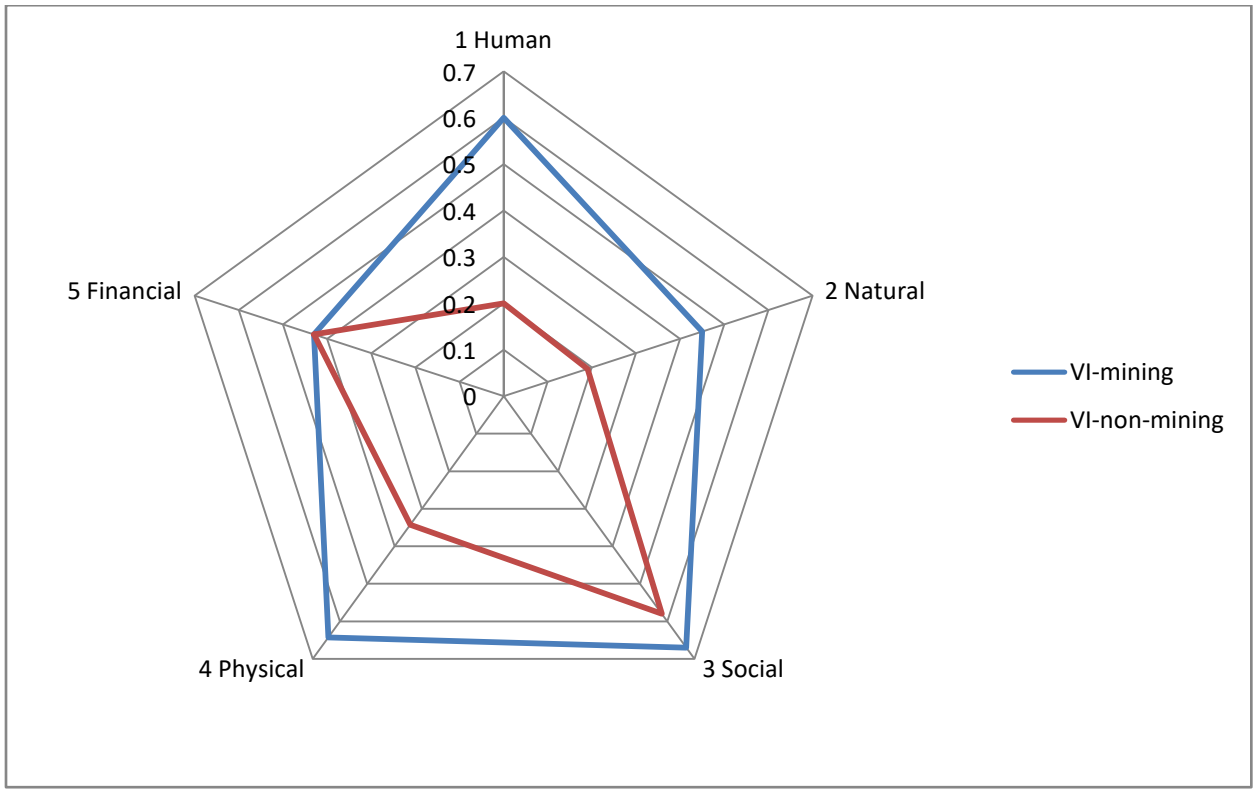


Figure 3: Radar Diagram Showing Vulnerability Index of the Five(5) Capital Resources of Both Mining And Non-Mining Communities



In mining communities social capital was found to be the most vulnerable resources or assets to the impact of mining with LVI of 0.66 as shown in Figure 3. This was partly due to the fact that "network and relationship" of households was found to be highly vulnerable to mining with LVI of 0.71 since 64% of households were found not to belong to any group and 78% were also found without any assistance from any organization. This was coupled with high demographic vulnerability index of 0.615 since 61% of households in mining communities were found not to have held leadership positions and this affected their social capital. However the same sub-components or indicators such as network and relationship as well as demographic factors accounted for high social capital vulnerability in non-mining communities. This is a clear indication that social capital is affected even in the absence of mining so the presence of mining worsens the situation. The radar diagram in Figure 3 shows how livelihood vulnerability index of subcomponents or livelihood indicators in mining communities are distinguished from that of non-mining communities.

In mining communities the second most vulnerable capital to the impact of mining was physical capital with vulnerability index of 0.643. This is explained by high road vulnerability index of 0.9 as a result of poor nature of the roads in mining communities which increases the

expected transportation time of travelling to the District capital hence hampering trading and marketing activities coupled with increased transportation cost. The poor nature of the roads was due to the heavy duty vehicles used by miners to ply the roads. Averagely it took households fifty-five (55) minutes to reach the District capital from various communities instead of fifteen (15) minutes due to the poor nature of the roads making some roads almost inaccessible unlike non-mining communities even though nature of road was also found to be vulnerable in non-mining communities. This occurred due to the fact that within the District the heavy duty vehicles used by miners ply roads that cover both mining and non-mining communities. For instance the heavy duty vehicles would have to pass through some non-mining communities before reaching its destination of mining communities. Human capital was found to be vulnerable to the impact of mining with a vulnerability index of 0.6. This could be explained by the fact that 53% of households were not access to farm labour due to the high labour cost as a result of shift in labour from agriculture to the mining sector. The amount paid by miners for a day is more than the amount paid by farmers for engaging a labourer for a day. However, unlike mining communities access to labour was not vulnerable with vulnerability index of 0.14. This implies there was no scarcity of labour in non-mining communities. This result conforms to that of Tieguhong et al., 2009 which states that artisanal mining is an attractive employment option in rural areas and barriers to entry are minimal (low technology and little capital is needed).

Access to extension training in mining communities was found to be highly vulnerable in mining communities with vulnerability index of 0.9 coupled with poor educational level having vulnerability index of 0.68. The high vulnerability index of human capital in mining communities evolved from high health vulnerability index due to the high incidence of malaria within the year as a result of the breeding of mosquitoes resulting from stagnant water in uncovered mining pits unlike non-mining communities. This result conforms to that of Hentschel 2000; 2002, Labonne and Gilman 1999; USAID 2000, UNESC 2003 which indicates that the main impacts of mining are: deforestation and land degradation; open pits causing animal traps and health hazards (including acting as mosquito breeding grounds due to stagnant water collection after being abandoned by the miners).

Using Propensity Score Matching to compare well being of rural households in mining and non-mining communities

A propensity score matching test conducted with respondents from mining communities as the treated and that of the non-mining communities as the counterfactual. Household consumption expenditure is used as a well-being measure since it is smooth over short term fluctuations,

capture long-run well-being levels, reliable and less vulnerable to under reporting bias for prior households with low resources (World Bank, 2001; Barnet et al, 2001, Meyer and Sullivan, 2003; and Ravallion, 2003).

Table 5: Results of PSM

. teffects psmatch (expcap) (min age fmlysz ms eductn fmsz fertlzr imseed extcnt train credit leader coop Lbrcost gender), nneighbor(3)

Treatment-effects estimation			Number of obs =		200	
Estimator : propensity-score matching			Matches: requested =		3	
Outcome model : matching			min =	3		
Treatment model: logit			max =	4		
Expcap	Coef.	AI Robust Std. Err.	z	P>|z|	[95% Conf. Interval]	
ATE						
Min						
(1 vs 0)	115.5676	69.40754	1.67	0.096	-20.46863	251.6039

Table 6: Results of PSM

. teffects psmatch (expcap) (min age fmlysz ms eductn fmsz fertlzr imseed extcnt train credit leader coop Lbrcost gender), atet nneighbor(3)

Treatment-effects estimation			Number of obs =		200	
Estimator : propensity-score matching			Matches: requested =		3	
Outcome model : matching			min =	3		
Treatment model: logit			max =	4		
expcap	Coef.	AI Robust Std. Err.	z	P>|z|	[95% Conf. Interval]	
ATET						
Min						
(1 vs 0)	143.0585	76.37207	1.87	0.061	-6.628018	292.745

From the propensity score matching result above the estimated ATE is 115.5676 meaning that annual household expenditure per capita which serves as a measure of well-being will be GH₵115.5676 more in mining communities than non-mining communities as shown in Table 5. Both the ATE and ATET are positive and significant at 10%. Thus households in mining communities are found to have a better well-being than those of non-mining communities. This is partly due to the boost in economic activities associated with miners and the diversification of households in order to generate more income as a results of higher cost of living leading to higher consumption expenditure per capita (well-being). This shows that the influx of miners in the mining communities had affected the annual consumption expenditure of rural households positively as compared to non-mining communities. This shows that respondents in mining

communities have higher consumption expenditure per capita and depicts their ability to maintain or improve their livelihood status whilst those in non- mining communities have lower consumption expenditure per capita and hence lower well-being. The propensity score matching result supports the significant difference in means of mining and non-mining communities.

SUMMARY AND CONCLUSIONS

The study provides information on the threat posed by mining activities on rural dwellers and its effect on their livelihoods. Most livelihood studies only focus on the threats and shocks that affect livelihood assets in communities without much emphasis on the indicators of the sustainable livelihoods framework.

The study found that indeed there was a threat of livelihood resources by the influx of miners and mining activities in the mining communities. Mining and its activities were known to affect the social, physical, human, natural and financial resources in mining activities. From the study, farmers lost arable lands and farms predominantly cocoa farms to miners coupled with scarce labour for farming. The Livelihood vulnerability index results show that the five livelihood capitals in mining communities are vulnerable to the detrimental effects of mining and its activities. Thus households' livelihoods are affected negatively by mining.

The propensity score matching result showed farmers in mining communities had a higher well-being compared to those of non-mining communities with similar features. This was due to the fact that annual consumption expenditure per capita which was used as a measure of well being of households in mining communities was higher because of relatively higher cost of living among rural dwellers in mining communities.

RECOMMENDATIONS

The study found that assets and livelihoods of farmers in mining communities were affected negatively by mining and its activities. This happened as a result of the uncontrollable nature of mining and its activities in mining communities.

The five capital resources being social, physical, human, natural and physical resources in mining communities were found to be vulnerable and affected by mining and its activities hence the study recommends that policies should be directed towards the protection of the countries' livelihood resources in mining communities. The capacity of regulatory institution such as Environmental Protection Agency, Lands Commission and Minerals Commission should be strengthened to protect and preserve the capital resources for sustainable livelihoods in mining communities.

RESEARCH LIMITATIONS

The study was limited to the Amansie West District since the influx of miners is rampant and also serves as exploitation for both legal and illegal miners as well as large and small scale miners even though the major occupation in the area is farming.

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LIST OF ABBREVIATIONS

AER	Annual Environmental Report
ASM	Artisanal Small Scale Mining
CHRAJ	Commission on Human Rights and Administrative Justice
COCOBOD	Ghana Cocoa Board
CSOs	Civil Society Organisations
DAs	District Assemblies
DFID	Department for International Development
EAR	Environmental Audit Report
EIA	Environmental Impact Assessment
EPA	Environmental Protection Agency
ERP	Economic Recovery Programme
FAO	Food and Agricultural Organisation
GDP	Gross Domestic Product
GNA	Ghana News Agency
GOG	Government of Ghana
GSD	Geological Survey Department
GSS	Ghana Statistical Services
GTZ	Gesellschaft Technische Zusannebarbeit
IDMC	Inspectorate Division of Minerals Commssion
IMF	International Monetary Fund
IRS	Internal Revenue Service
LSM	Large Scale Mining
MC	Minerals Commission
MDAs	Ministries, Department and Assemblies
MIDA	Millenium Development Authority

MoFA	Ministry Of Food and Agriculture
MoTI	Ministry of Trade and Industry
MPs	Member of Parliaments
NCOM	National Commerce Corporation
NGO's	Non-governmental Organisations
PMMC	Precious Mineral Marketing Company
PNDC	Provisional National Defense Council
SAP	Structural Adjustment Programme
SHD	Sustainable Human Development
SL	Sustainable Livelihood
UNDP	United Nations Development Programme
WB	World Bank