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EVALUATING THE EFFECTS OF ILLEGAL MINING ON COCOA PRODUCTION AND QUALITY IN GHANA'S AMANSIE WEST DISTRICT IN THE ASHANTI REGION

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Abstract

Mining is a significant economic contributor in mineral-rich developing countries. It makes a sizable contribution to the nation's Gross Domestic Product. Illegal mining is typically carried out by removing all the top soil that supports agriculture before mining the highly sought-after minerals. This results in significant damage and effects, not only on the land, but also on the water and, at times, on the air. Illegal mining contributes to biodiversity loss, land degradation, and soil depletion of vital nutrients and organic matter. Agriculture is a significant source of employment in the majority of developing nations, including Ghana. Cocoa is a significant cash crop grown on agriculturally productive grounds, but mining competes with cocoa not just for land, but also for the loss of arable ground. Mining's benefits and costs have become a point of contention. The survey discovered that mining activities had deprived farmers of good and stable land. Residents of these settlements in Ghana's Ashanti Region's Amanisie West District have faced difficulties as a result of the degradation of agricultural areas, standing forests, and rivers. The purpose of this study was to determine the influence of illegal mining on cocoa output and quality in the Amansie West District. Using structured questionnaires and field observations, data on the impact of illegal mining in relation to the presence of heavy metals was acquired. The study was performed to ascertain the opinions of cocoa farmers in the district's three (3) agricultural zones on the actions of illegal miners vying for the same land on which they farm or aspire to farm.

Keywords*: Illegal mining, Quality, Agriculture, Gross Domestic*

INTRODUCTION

Cocoa is one of the most valuable crops on the planet, planted on every continent, contributing significantly to the social and economic well-being of over five million households and affecting over twenty-five (25) million people (Van Himme, 2001).

Agriculture is the primary source of livelihood in Africa, and Ghana is no different. Ghana's primary cash crop is cocoa, and the country is the world's second largest producer of cocoa beans. Cocoa has been a crucial pillar of the country's economy for many years, dating all the way back to the colonial era. Ghana has continued to pursue and implement policies and initiatives aimed at increasing cocoa production (Ahenkorah et al., 1982; Osei, 2007; Dorman et al., 2009).

Every mineral in its natural state located in, beneath, or upon land in Ghana, rivers, streams, and water courses throughout the country, the exclusive economic zone and an area covered by the territorial sea, or the continental shelf, is the Republic of Ghana's property and is vested in the President in trust of the Ghanaian people (Minerals and Mining Act 2006, (ACT 703)). (Section 1). Since there is no land without an owner in the country, the land on which these minerals are deposited definitely belongs to a particular individual, clan, tribe or king.

Mineral-endowed developing countries have increased their dependence on the extractive sector with the belief that it will help them to achieve their developmental objective (Ross, 2001). Countries endowed with these mineral resources have a link between efforts towards poverty reduction and the performance of the framework for the mining sector. The mining sector framework relies on commercial-scale mining as a source of foreign exchange and fiscal receipts for governments. In developing countries, there is the belief that commercial-scale mining sector will provide jobs and employment to the local people. Apart from large-scale mining, small-scale mining operations in developing nations such as Ghana, Tanzania, Burkina Faso, and Bolivia employ approximately thirteen million (13,000,000) persons (IFC, 2003).
Ghana is Africa's second greatest gold producer, after South Africa, according to Barning (1997). Ghana is also Africa's third largest producer of aluminium and manganese ore, as well as a significant producer of diamonds and bauxite (Minerals Commission, Ghana).
Ghana, formally the Republic of Ghana, is a sovereign multiparty state that practises a unitary presidential constitutional democracy. It is located in West Africa, between the Gulf of Guinea and the Atlantic Ocean. Ghana has a landmass of 238 thousand, 535 kilometres (238,535 km). Ghana is bounded on the west by Ivory Coast, on the north by Burkina Faso, on the east by Togo, and on the south by the Gulf of Guinea and the Atlantic Ocean. Ghana is a Mande term that translates as "Warrior King." Ghana lies between latitude 4º and 12º North and longitude 4º West and 2ºEast and the Prime Meridian passes through Ghana's industrial post town of Tema (Wikipedia) (Grant 2008).

Ghana has a long history of mining of gold using traditional methods (Hilson 2001). These indigenous methods of mining gold were highly productive with a long history of evolution and techniques. The presence of the colonial masters in the 19th century outlawed traditional methods used by the indigenes for gold extraction and that paved the way for modern modes of extracting minerals. This made the mining of these precious minerals an exclusively foreign run enterprise.

Even though certain traditional authorities benefitted from Through the granting of mining concessions, it was European mining firms and the Colonial Government that amassed the majority of riches at the time.
Due to emerging countries like Ghana's reliance on resource extraction, the extractive sector now accounts for 50% of Africa's exports and attracts 65% of all Foreign Direct Investment (FDI) in the region (IFC 1999). It attracted a diverse group of mining corporations from industrialised nations including the United States, the United Kingdom, Australia, Canada, and South Africa. These countries own a majority stake in the majority of Ghana's mining companies. According to Akabzaa et al. (2004), there is rising disagreement concerning the net advantages of these investments to the country as a whole and to the people impacted directly by mining. Conflicts have erupted between affected communities and mining firms as a result of this occurrence.

Gold mining has been critical to Ghana's socioeconomic progress (Tenkorang 2001). However, in recent years, the mining of these minerals in Ghana has resulted in environmental degradation (Kwarteng, 2003). The procedure liberates previously imprisoned heavy metals from the earth. Rainwater leaches these compounds and heavy metals from exposed soils, resulting in long-lasting heavy metal contamination. Arsenic (As), manganese (Mn), copper (Cu), mercury (Hg), lead (Pb), and zinc are all examples of these heavy metals (Zn). The Mercury Act of 1989 was designed to address the threat of these heavy metals being released into the environment. Sanctions include license revocation, a fine of up to 500 penalty units, and a period of imprisonment of up to two years (Mercury Act). Any of these punishments may be imposed, and in extreme situations, all of them or just two may be imposed, on a miner or company that misuses Mercury (Mercury Act, 1989).

Though Ghana's economy is predominantly agrarian, employing around 60% of the population and accounting for approximately 36% of Gross Domestic Product (GDP), agriculture is the primary source of livelihood for the people of West Africa. Agriculture provides jobs for agrochemical producers and distributors, seed breeders, entomologists, and fisheries personnel, among others. The Ashanti Region existed as Ashanti Kingdom in the 19th century to 1902. It became a Protectorate in 1902 to 1935. In 1935 to 1957 it became a Sovereign State. From 1957 to date is a State Union. It falls within the coordinates of 6º 45'N and 1º 30' W. Ashanti Region has a total land area of 24, 389 km^2 (9,417sqmi). It is the third largest of the ten (10) administrative regions with Kumasi as the capital. Ashanti is known for its major gold and cocoa production.

The Region has 30 administrative districts. It lies in a forest zone and timber producing area. The Region shares regional boundaries with Brong Ahafo to the North, Western Region to the West, Eastern Region to the East and South with Central Region.

In 1988, the Amansie West District was created by curving the former Amansie District. The district is bounded on the west by Atwima Nwabiagya and Atwima Mponuah, on the east by Bekwai Municipality, Amansie Central and Obuasi Municipality, on the north by Atwima Kwawoma, and on the south by Upper Denkyira and Bibiani. The district acts as a regional boundary between Ashanti and the Central and Western Regions on the one hand, and the Central and Western Regions on the other. The district is located at latitude 6o 05 west, longitude 6o 35 north, latitude 1o 40 south, and longitude 2o 05 east. It is one of the largest districts in the region, with an area of around 1,364 square kilometres. Its capital is Manso Nkwanta, approximately 65 kilometres from the regional capital Kumasi. The districts contain settlements such as Abore, Agyroyesum, Antoakrom, Pakyi No. 1 and No. 2, Datano, Mpatuam, and Keniago, among others. The surrounding regions and districts serve as a marketing hub for goods and services. With its enormous geographical area, the country has access to agricultural land for the promotion of rice, citronella, cocoa, oranges, and oil palm plantations to feed agriculture and related sectors.

At a height of 210mm above sea level, the district's topography is undulating. A significant feature is the range of hills that runs from the district's northwestern corner to Manso Nkwanta and Abore. The hills range between 560mm and 630mm in elevation. In the north, the district is well-drained by the Offin and Oda Rivers, which have tributaries in the Jeni, Pampin, and Emuna Rivers. The district has a humid semi-arid climate. It has a two-season rainfall regime, with the major rainy season occurring between March and July and the minor rainy season occurring between September and November. This makes the territory ideal for income and food crop cultivation. The district's vegetation is predominantly rainforest, with wet semi-deciduous features, creating an opportunity for rich and acceptable agricultural investments in food and cash crops. Through human activities such as shifting cultivation, slash and burn agriculture, illegal mining, and logging, a mosaic of secondary forest has been gradually destroyed and rebuilt. The district has four major forest reserves: Oda River Forest Reserve, Apanprama Forest Reserve, Jimira Forest Reserve, and Gyemi Forest Reserve.

The district has a total of six (6) major soil types. These are the Bekwai-Oda Compound Association, a well-drained red gravelly soil that is typically found near Abore, Dome-Keniago, Antoakrom, and Odaho. The second is the Ahwam – Kakum – Chickiwerem Association, which is characterised by reddish brown, well-drained loam to clay loam in the Nyamebekyere and Adagya areas. The third, located approximately halfway between Datano and Aboabonso, is the Mim Oda Compound, which is densely forested with stones and gravels. The Bekwai Zongo Oda Complex, which surrounds Esaase, is the fourth soil type. The Nyanoo-Tinkorang Association is the fifth soil type found in Abore's hilly regions. The sixth and final is the drought-prone Kobeda Eschiem Subinso Oda Complex, which is located between Manso Nkwanta and Essuowin.

The District may contain significant gold reserves. A sizable portion of the land has been bought and concessions granted to several prospecting companies. Apart from the huge businesses with extensive concessions in the territory, there are pockets of small-scale mining organisations that utilise extremely primitive methods of gold recovery, with a sizable proportion of the district's young involved. The district use be forest but has lost its priority and importance.

Sector	Percentage Employed
Agriculture	70.7
Service	08.0
Manufacturing/ Mining	22.0

According to the 2000 National Population and Housing Census, the district had a population of 108,273, or approximately 3.0% of the regional population. The current prediction is 144,104, with 3.8 percent urban residents and 96.2 percent rural residents. Males make up 49.1 percent of the district's population, while females make up 50.9 percent (AWDA). The district labour force (defined as those who are economically engaged between the ages of 16 and 64) accounts for around 49.0 percent of the total population.
The following table 1.1 summarises the district's labour force.
MOFA – AWDA 2014

Due to the existence of mining activities, there is an influx of skilled and unskilled youngsters from outside the District seeking employment opportunities.
Farming constitutes the major sources of employment and income in the district. The agriculture sector employs about 70.0% of the total labour force which is dominated by crop farming and animal rearing (Composite Budget Amansie West District, 2014 Fiscal Year). The major crops grown are maize, cassava, plantain etc. Industrial crops such as oil palm, cocoa, coffee and cashew are also grown. The District is endowed with mineral resources. Due to the

mining of these resources in the district, the mining communities have experienced a growth in business activities in mining related industries.

LITERATURE REVIEW

Mining as Land Use

Land use can be defined as the management of land to meet human needs. Some of the human needs of land use are sand and stone winning; mining of minerals in the land, habitat and agriculture which includes cocoa farming. Land use embraces forestry, agriculture as well as other forms of industrial and urban use. According to Evans (2010), land use also entails the application of human controls to the critical aspects of an ecosystem in order to maximise its benefits. By contrast, mining can be defined as the process of extracting precious minerals and other geological elements from the earth's surface. Mining is also a term that refers to the process of removing dirt, specifically sand, stones, and gravel. Mining is used to extract precious metals (such as gold, diamond, and bauxite), iron, limestone, oil shale, rock salt, and potash from the earth.

According to Langer (1988), mining is the process of extracting non-renewable resources such as petroleum, natural gas, soil, or even water. Mining dates all the way back to the prehistoric past, when stone and metals were extracted from the soil. Langer (1988) continued by stating that modern and organised mining processes include prospecting for ore bodies, analysing the profit potential of a proposed mine, extracting the desired materials, and finally reclamation of the land to prepare it for future uses.

How Mining Affects Agriculture

Mining and agriculture are inextricably intertwined due to their mutual reliance. While mining companies have indirectly enhanced infrastructure in ways that may help agricultural development, the results of this interaction appear varied, with agriculture diminishing in some regions depending on local factors. Mining and agriculture are inextricably intertwined by their need on land and water resources. Local conflicts can emerge when mining is believed to be in competition with agriculture, livestock grazing, or other traditional land uses (Minerals Council of Australia). Displacement and resettlement of farmers from mining areas have also resulted in conflict, as equivalent land cannot be obtained and farmers without land titles are excluded (Minerals Council of Australia).

Mining and its effect on Agriculture and Cocoa

Mining can be particularly environmentally harmful, destroying top soils and economically significant trees. Mining has irreversibly altered the surrounding landscape over time. For example, extensive swaths of land are cleared of cocoa trees to obtain access to the mineral underneath, exposing a great amount of often productive topsoil to the environment, which erodes and gathers in surrounding water bodies. Wergon (1991) asserts that removing big woody debris from the source during mining extraction activities has a detrimental effect on plant communities. This huge woody debris is critical for preserving and regenerating plants in streamline areas. Several of mining's negative consequences include the following:

- the inability to hunt and gather
- the inability to move freely
- settlement relocating

• flagrant disregard for tradition
• land use conflicts between members of the community and mining firms, people, and other institutions.

Impact of Mining on Physical and Chemical Properties of Soil

Trees (including cocoa) and biomass from these maintains and improves soil physical properties. Higher availability of soil water can be maintained under tree due to the inception and re distribution of rain water within the system, reduced evaporation and infiltration (Breman and Kessler, 1995; Wallace 1996). When tree and vegetation cover are removed because of mining activity, these properties are adversely affected (Adewole and Adesina, 2011). Mining has a significant impact on the air and water, resulting in biodiversity loss and soil pollution, which contributes to land degradation (Pandey and Kumar, 1996). Mining also results in the eradication of flora, the depletion of critical nutrients and organic matter in the soil, as well as a decrease in the soil's biological activity and production (Pandey and Kumar, 1996). Mineral exploration has a direct or indirect effect on both living and non-living organisms through modifying the physical and chemical environment of the soil (Ratacliff, 1974). All of these factors contribute to reduced crop productivity in mining-affected areas.

METHODOLOGY

Research Design

The study employed the mixed method research design to enable the researchers explore the effects of illegal mining on the production and quality of cocoa. Structured and semi-structured questionnaire were used in gathering data from respondents. The sample size for the study was determine using the formula $n=N/1+N(a)^2$ (Israel 1992) where

n= the required sample size
N = sample frame/ population size
a = deserved level of precision or confidence level.

With the sample frame of population and 90 percent confidence level (0.10). The size was estimated at ninety (90) using the $n = 927/1+927(0.10)^2$ The statistical tools used in the analysis were SPSS and Excel. The socio-demographic characteristic of the data was carried out to bring out the significance of residents' perception of the impact of mining in the district.

ANALYSIS AND DISCUSSION OF RESULTS

Analysis on how Farming Business is Affected by Mining

The respondents were asked to indicate whether or not mining affects the farming business in the area. Table1 below shows their responses:

Table 1: Frequency of farming business is affected by mining

Yes	90	100.0
No	0	0.0
Total	90	100.0

Source: Field Survey, 2021

It was important to know whether or not farming business in the areas is affected by mining. From Table 1, it can be seen that all the respondents, 90 representing 100% of the farmers, said that mining affects farming business in the area. The findings of the study confirm the several negative effects of illegal mining on natural lands and agriculture in Ghana revealed by previous studies on mining effects. Previous studies on mining (Wergon, 1991; Armah et al, 2010;

Fernando and Juan, 2012; Boateng et al, 2014 ;) have revealed several harmful effects it poses on the environment and agriculture in Ghana. In line with the previous studies, this study has shown that illegal mining has negatively affected the land, soil, afforestation, and cocoa production in the Amansie West District. The proximity of mining sites to the farms, loss of farmlands to miners, and the presence of heavy metals in the soil negatively affecting the quantity and quality of cocoa yields in the district are the negative effects of illegal mining in the district.

Proximity of Farms to Mining Site

Respondents were asked to show the proximity of their farms to mining sites. Table 2 shows their responses.

Table 2: Frequency on proximity of farm to mining site

Far away	15	16.7
Not far	32	35.6
Close	43	47.8
Total	90	100.0

Source: Field Survey, 2021

Majority of the farmers have their farms close to mining sites. As shown in Table 2, about 43(47.8%) of the farmers have their farms close to mining sites. 32(35.56%) indicated their farms are not far, that is, not so close to the mining site. Only 15(16.7%) have their farms far away from mining sites.

Level of Cocoa Production

It was necessary to find out how the cocoa in the area yields; whether it yields low or high, or whether the yield is normal. Table 4.8 shows the responses of the respondents with regard to the yield.

Table 3: Frequency on level of cocoa production

Normal yield	31	34.4
Less yield	42	46.7
High yield	17	18.9
Total	90	100.0

Source: Field Survey, 2021

With the level of cocoa production, majority of the respondents indicated their cocoa yield less. As shown in Table 3 about 42(46.7%) of the farmers have their cocoa yielding less; only 17(18.9%) of them have their cocoa yielding high. For the remaining 31(34.4%) there is a normal yield.

Level of Satisfaction with the Quality of Farmers' Cocoa

Respondents were asked questions regarding satisfaction with the quality of the cocoa they harvest. Their responses are shown in Table 4.9 below:

Table 4: Frequency on the level of satisfaction with the quality of farmers' cocoa

Very satisfied	16	17.8
Satisfied	32	35.6
Not satisfied	42	46.7
Total	90	100.0

Source: Field Survey, 2021

The majority of the farmers are not satisfied. As shown in Table 4, about 42(46.7%) of the farmers are not satisfied with the quality of the cocoa they harvest. Only 16(17.8%) are very satisfied. The remaining 32(35.6%) however, are satisfied.

Level of Annual Cocoa Production

Respondents were asked to show the level of annual cocoa production. Table 5 presents their responses.

Table 5: level of annual cocoa production

Normal yield	39	43.3
Less yield	40	44.4
High yield	11	12.2
Total	90	100.0

Source: Field Survey, 2021

As it can be seen from the table above that, 40(44.4%) of the extension agents indicated less yield; 39(43.3%) indicated normal yield. Only 11(12.2%) of the agents indicated high yield.

Level of Satisfaction with the Quality of the Cocoa

The agents who responded were asked to indicate the extent to which they were satisfied or not satisfied with the quality of the cocoa. Table 4.12 presents their responses:

Table 6: Level of satisfaction with the quality of their cocoa

Very satisfied	23	25.6
Satisfied	34	37.8
Not satisfied	33	36.7
Total	90	100.0

Source: Field Survey, 2021

From the Table 6, it can be seen that majority of the respondents were not very satisfied with the quality of the cocoa produced. Only 23(25.6%) showed they were very satisfied. Though 34(37.8%) were satisfied, about 33(36.7%) are not satisfied at all with the quality of the cocoa.

Awareness of Mining in the Area by Buyers

Buyers of the cocoa were asked to indicate whether or not they were aware of mining in the area they have been buying cocoa from. Table 4.13 shows their responses:

Table 7: Buyers' awareness of mining in the area

Yes	57	83.8
No	11	16.2
Total	68	100.0

Source: Field Survey, 2021

From the Table above it could be inferred that, majority of the cocoa buyers are aware of mining in the area. 57(83.8%) of the respondents said they are aware. Only 11(16.2%) indicated they were not aware.

Level of Changes Buyers Have Observed in the Quantity of the Cocoa

The buyers were asked to indicate the level of changes (reduction or increase) in the quantity of the cocoa they buy from farmers in the area. Table 8 summarizes their responses:

Table 8: Level of changes buyers have observed in the quantity of the cocoa

Little change in the quantity produced	43	63.3
Significant reduction in the quantity produced	18	26.5
Normal production is always obtained	7	10.3
Total	68	100.0

Source: Field Survey, 2021

From the Table it can be seen that majority of the buyers observed a change in the quantity of the cocoa. Though 43(63.3%) noticed little change in the quantity, 18(26.5%) noticed a significant reduction in the quantity produced. Only 7(10.3%) indicated that normal production is always obtained.

Buyers' Observation When Quality of the Cocoa Production Started to Decline

The buyers were again asked to indicate their awareness or observation when the quality of the cocoa began to decline. Table 9 shows their responses:

Table 9: Buyers' observation when quality of the cocoa production started to decline

Yes	48	70.6
No	20	29.4
Total	68	100.0

Source: Field Survey, 2021

From the Table it is seen that 48(70.6%) of the farmers observed the decline in the quality of the cocoa when it started to happen. However, 20(29.4%) did not observed it at the start.

Heavy Metals in Soil and Root Samples

Table 10 shows levels of heavy metals (Lead Cadmium and Mercury) in the soil and plant samples from the Amansie West district.

Table 10: Concentration of heavy metals in soil and root samples at 0 to 20 cm and 20 to 50 cm

Treatment	Lead (µg/g)	Cadmium (µg/g)	Mercury (µg/l)
Depth of Soil sample (cm)			
0-20	3.75	1.18	3100
20-50	4.77	1.12	3208
LSD (5%)	NS	NS	NS
Root sample (cm)			
0-20	3.07	0.57	4120
20-50	2.95	0.87	2351
LSD (5%)	NS	NS	NS
CV (%)	29.2	83.2	76.6

The above results indicate the presence of Lead, Cadmium and Mercury in both root and soil samples. No significant difference (p>0.05) as indicated by the results implies that both the soil and the root samples at various depths were equally exposed to the heavy metals. There is also a trend of increasing levels of heavy metal with increasing depth of soil and decreasing levels of heavy metals in the case of the root. This shows that the soils are more permeable to these metals than the root and can allow for more of these heavy metals to pass through them. For the roots, this indicates that the contamination by these metals begins from the upper part of the root (crown) and as the concentration increases it permeates down to lower portions. The above result declared is seen in the case of Lead and Mercury whiles Cadmium follows an opposite trend. There was also no significant difference (p>0.05) per the locations chosen. This indicates that similar results are depicted in all three locations from which samples were taken. Heavy metals (Lead, Cadmium and Zinc) were found in the soil and root samples from the study area through a laboratory assay. The presence of heavy metals in the soil as detected by the laboratory assay is in agreement with studies conducted by other researchers at the World Health Organization who reported that heavy metals although present in the soil is only released by mining and mining related activities as the metal is locked up in the soil (WHO, 1992). Other sources which have been reported to release these metals to the soil upon application include fungicides, fertilizers and sludge (Tangahu *et al.,* 2011). These sources however were either not present or did not play a significant role in contributing to levels of heavy metals in the study area.

Table 11: Concentration of heavy metals in soil and root samples at 0 to 50 cm

Treatment	Lead (μg/g)	Cadmium (μg/g)	Mercury (μg/l)
Depth of Soil sample (cm) **0-50**	8.52	2.3	6308
Root sample (cm) **0-50**	6.02	1.44	6471

The concentration of Lead in the soil sample for the district was 8.52 μg/g and that of the root was a little lower with its concentration at 6.02μg/g. This implies that there is a gradient between the concentrations of the soil and the root. Thus, the roots absorb some amounts of lead as it does with nutrients and this is passed on to the other parts of the crop including the bean.

Levels of Cadmium were also found in the both the root and the soil samples these were 2.3 and 1.44 μg/g respectively. This also establishes the fact that a positive gradient exists between the soil and the root and therefore residues of could be found in the bean. Mercury also had some levels both in the root and the soil but the soil – root gradient in the case of Mercury was negative. Thus, higher concentrations of mercury were found in the root as compared to the soil.

Heavy Metals in Cocoa Bean Samples

Table 12, show levels of heavy metals (Lead Cadmium and Mercury) in the soil and plant samples from the Amansie West district

Table 12: Levels of heavy metals in Cocoa Samples in Comparison to IAEA – V-10 Standard reference materials (Hay Powder)

Lead (μg/g)	FEED1	FEED2	FEED3	MEAN	STANDARD
Cadmium (μg/g)	0.006	0.005	0.009	0.007	1.6
Mercury	0.76	0.71	0.72	0.73	0.03

The presence of heavy metals in the cocoa beans is confirmed by the above results. On the average, Lead had the least (0.007) concentration in μg/g. This is followed by the concentration of Mercury and Cadmium which was 0.012 and 0.73μg/g respectively. Average concentration of lead (0.007μg/g) in cocoa beans from the district was lower than the IAEA-V-10 standard reference material (Hay Powder) which is 1.6 μg/g. In a sharp contrast, the concentration of Cadmium in the cocoa beans was 0.73 μg/g which was higher than that of the SRM (0.03 μg/g). Levels of heavy metals were also detected in the cocoa beans. The level of lead reported in the bean was lesser than the IAEA-V-10 standard reference material (Hay Powder) which is in tandem with studies conducted by (Amankwah, 2013; Asante, 2013) where they reported the presence of these metals in the beans and the levels were also below the SRM reference standard. In contrast to Lead, levels of Cadmium in the cocoa beans were higher than the SRM standards. This might have been influenced by the soil chemical properties such as low pH. Lower levels of Mercury were detected in the Cocoa bean in comparison to the standard reference material. Since the build of the concentration in the soil is gradual, the build-up in the bean would also rise with time if nothing is done to prevent the inflow of mercury into the water bodies by extension the soil, with time. Levels of heavy metals were also detected in the cocoa beans. The level of lead reported in the bean was lesser than the IAEA-V-10 standard reference material (Hay Powder) which is in tandem with studies conducted by (Amankwah, 2013; Asante, 2013) where they reported the presence of these metals in the beans and the levels were also below the SRM reference standard. In contrast to Lead, levels of Cadmium in the cocoa beans were higher than the SRM standards. This might have been influenced by the soil chemical properties such as low pH. Lower levels of Mercury were detected in the Cocoa bean in comparison to the standard reference material. Since the build of the concentration in the soil is gradual, the build-up in the bean would also rise with time if nothing is done to prevent the inflow of mercury into the water bodies by extension the soil, with time.

CONCLUSION

Presence of heavy metals were indeed detected both soil, plant and cocoa bean sample. The levels found in them were generally below accepted standards except for levels of cadmium in the cocoa bean sample. These confirms the assertion that mining and mining related activities can influence the availability of heavy metals locked deep down in the soil which is naturally below the reach of plants. Consequently, these heavy metals found in the beans would have an impact on the quality of cocoa related products thus compromising the safety of consumers if levels are above acceptable standards.

REFERENCES

- Adewole M. B. and Adesina M. A., (2011). Impact of marble mining on soil properties in a part of Guinea Savanna Zone of Southwestern Nigeria. Vol. 4 No. 2 (2011) DOI:10.4313/ejesm.X412.1
- Ahenkorah Y., Halm B, J. and Appiah, S. (1982). Inositol penta- and hexaphosphate content of some cocoa soils in Ghana. Zeitschrift fur Pflanzenerahrung and Bodenkunde 145 (6) 586 – 592, 1982.
- Akabzaa, T. M., Banoeng-Yakubu, B. K. and Seyire, J. S. (2004). Impact of Mining Activities on Water in the vicinity of Obuasi Mine.
- Amankwaah D. (2013). Levels of Some Heavy Metals and Proximate Analysis of Cocoa Beans from Eastern and Central Regions of Ghana. *Unpublished MPhil Thesis, KNUST*.

- Armah, F. A., S. Obiri, D. O. Yawson, A. N. M. Pappoe, and A. Bismark (2010) "Mining and Heavy Metal Pollution: Assessment of Aquatic Environments in Tarkwa (Ghana) using Multivariate Statistical Analysis," *Journal of Environmental Statistics Vol. 1 (4).*
- Asante N. W. (2013). Levels of Some Heavy Metals and Nutritional Compositions of Cocoa Beans from Selected Cocoa- Growing Areas in Ashanti and Western Regions of Ghana. *Unpublished MPhil Thesis, KNUST*.
- Barning, K. (1997). "Industrial mineral resources of Ghana," Accra: Ghana Minerals Commission.
- Breman H and Kesseler, J. J. (1995). Woody plants in agro-ecosytem of semi-arid and regions with emphasis on the Sahelian countries. Springer – Verlag, Berlin.
- Impact of illegal small-scale mining (Galamsey) on cocoa production in Atiwa district of Ghana, *International Journal of Advance Agricultural Research, 2 (2014) 89-99*
- Evans, K. D., (2010) MSc. Lecture notes, land use. Analysis and Classification. Department of Agroforestry. Faculty of Renewable Natural Resources, Kwame Nkrumah University of Science and Technology.
- Fernando M. and Juan Pablo Rud, 2012. Mining, pollution and agricultural productivity: evidence from Ghana. America Economic Journal: Economic Policy.
- Hilson, G. (2001). "A contextual review of the Ghanaian small scale mining industry." London: Imperial College Center for Environmental Technology.
- International France Corporation (IFC). Priority on Africa. Nov 14 -28, 1999.
- International France Corporation. Annual Report 2003, On Africa.
- Israel, D. Glenn, 1992. Determining sample size. University of Florida Cooperative Extension Services, Institute of Food and Agriculture Sciences, EDIS 25, 1992.
- Langer, W. H., (1998) Natural aggregate of the conterminous United States. U.S. Geology Survey Bull. 1954. U.S. Geological Survey. Denver CO
- Minerals and Mining Act, 2006 Act 703. Natural Resource and Mining Act. Constitution of Ghana.
- Osei A. K. (2007). Poverty, Profile and correlates of poverty in Ghana – International Journal of Social Economics (34). July 449 – 471. DOI: 10.1108/03068290710760236.
- Pandey, D. D., and Kumar, S., (1996) Impact of Cement Dust Pollution on biomass, chlorophyll, nutrient and grain characteristics of wheat. Environmental Ecology 14(4): 872- 875.
- Tanguhu B. V., Abdullah S. R. S., Basri and Hojand Idris M., (2007). Heavy metals uptake by plants through Phytoremediation, 2011. International Journal of Chemical Engineering 2011 (1687-806X). DOI: 10. 1155/2011/939161.
- Tenkorang, C.O. (2001) Cyanide Spillage by Goldfields Ghana Limited. Daily Graphic pg 3. Graphic Group Communication LTD. Accra.
- The Mercury Act of Ghana (1989). PNDCL 217- Constitution of Ghana.
- Van Himme, M. and Saoeck, J. (2001). In: Raemaekers, R., ed.: "Crop Production in tropical African". DGIC. Directorate Generalle International Co-operation, Brussels, Belgium, pp889-921.