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The Economic and Environmental Impacts on Clay Harvesting at Abonko in the Mfantsiman West District of Central Region, Ghana

Kofi Asante-Kyei[a]*, Alexander Addae[b]

[a]*Senior Lecturer, Department of Ceramics, Takoradi Polytechnic, P. O. Box 256, Takoradi, Ghana.*
[b]*Lecturer, Department of Ceramics, Takoradi Polytechnic, P. O .Box 256, Takoradi, Ghana.*
[a]*E-mail: asantekyei@yahoo.co.uk Telephone: +233244544836*
[b]*E-mail: alexanderaddae@yahoo.com Telephone: +233244526422*

Abstract

Basically, clay is a natural earth material with plastic properties. It becomes cohesive when kneaded, expands when wet, shrinks when dry and gains strength when fired. In Ghana, Clay is a widely distributed and abundant natural mineral resource for mainly industrial and economic importance for variety of uses. In Ghana, the most common and famous way of clay harvesting is by open pit method. Most clay harvesters normally abandon the harvested site after their harvesting activities without any effort to reclaim it. Therefore, the main purpose of the study is to find out the economic and environmental impact of clay harvesting at Abonko in the Mfantsiman West District of Central Region, Ghana. Ten (10) people were randomly selected from four sampling sites. That gave a total sample size of Forty (40) for the study. The main instruments used for collecting data were structured questionnaire, interviews, observation of site, and community base response survey. Raw data collected had been assembled, analyzed, and the results presented using frequency distribution tables. It was realized, among others that even though, the clay harvesting was lucrative business at Abonko, only land owners enjoyed the booty. The closeness of the clay harvesting sites to river bodies was a major source of pollution to the water bodies. It further came to light from the analysis that 95% of the respondents agreed that the harvested lands were not reclaimed, thereby entrapping domestic animals, and also serving as breeding grounds of mosquitoes. It was recommended among others, there should be establishment of clay harvesting business unit to ensure that the business could lure to the benefit of the whole community, educational programs should be organized for clay harvesters in the area by the Environmental Protection Agency (EPA).

Keywords: clay; degradation; economical; environment; harvesting.

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* Corresponding author.

1. Introduction

Basically, clay is a natural earth material with plastic properties. It becomes cohesive when kneaded, expands when wet, shrinks when dry and gains strength when fired. According to Worrall [1], clay is an earth that forms a coherent mass when mixed with water; when wet, this mass is readily mouldable, but if dried it becomes hard and brittle and retains its shape. Additionally, if heated to redness, it becomes still harder and is no longer susceptible to the action of water. Clay in its dry state, is a crumbly earth material that is soft and easily modeled (plastic) when wet, holds its shape when formed and dried [2]. Clay should not be confused with soil – a combination of clay, sand, humus (partially decayed vegetable matter), and various other minerals. In its raw state (before it has been fired), clay can be powder, liquid, plastic, leather hard and bone dry. The use of clay for pottery, ceramics and clay figures had already been known by primitive people about 25000 years ago [3]. In recent times, clay is used as adsorbent, decolouration agent, ion exchange, and molecular sieve catalyst [4]. According to Worrall [1], clay can be used in the paint industry, paper-making industry, and generally clays are important constituents of the soil in agriculture industry.

1.1 Clay Deposits in Ghana

According to research findings by the Building and Road Research Institute (BRRI) of the Council of Scientific and Industrial Research (CSIR) and the Geological Survey Department of Ghana indicate that there are enough clay deposits in all the ten regions in Ghana. Some of the places identified include: Sumbrugu in the Upper East; Atamore in the Upper West; Koblimahago in the Northern Region; Aferi, Mfensi, Kasi and Asokwa in Ashanti Region. Others are Sunyani and Tanoso areas in the Brong Ahafo Region; Somanya, Asuogya, Akim Swedru, Kibi and Abepotia in the Eastern Region; Nzema areas, Bokazo, Nkroful and Essiama in Western Region; Ankaful, Ajumako, Abonko, Winneba and Afrankwa in the Central Region; Ada Kasseh and Afienyo East in Greater Accra; and Danyi, Kadjebi, Adutor and Adidome in the Volta Region [5].

1.2 Clay Harvesting in Ghana

In Ghana, the most common and famous way of clay harvesting is by open pit method. This method is normally done by using various kinds of equipment such as power shovels, backhoes, draglines, front-end loaders, shale planers, and scraper-loaders [6]. Similar to man-made activities, clay harvesting activities even though economical, cause significant impact on the environment [7]. Extraction of raw materials like clay from their natural habitats has a consequential effect on the natural environment [8]. The effects resulted from clay can be enormous, such as air and water pollution, soil erosion, geo-environmental disasters, loss of biodiversity, and loss of economic wealth [9].

It must be stated that clay harvesting like mining activities removes earth surface, piling it over untilled land and forming chains of external dumps, which one way or the other affects the soil nutrient cycle of the area [10] and [11]. Again, stockpiling of top soil in mounds during mineral extraction has been revealed to affect chemical, biological and physical properties of soil [12,13,14]. According to Davis [15], mines both active and inactive, are potential water contamination sources. Freeze and Cherry [16] opine that drainage of materials from

abandoned pits can act as ground water contamination source for years after mining operations have stopped. Eroded and drained materials could fill and cement water bodies. Runoff after heavy rainfall often increases the sediment load of nearby water bodies.

Figure1: clay harvesting site at Abonko

Figure 2: mining of clay affecting water body at Abonko

Johnson [13] posited that, minimizing the disturbed organic material that ends up in nearby streams or other aquatic ecosystem represents a key challenge at many mines. In addition, clay harvesting like mining activities may modify stream morphology by distorting channels, diverting stream flows and changing the slope or bank stability of a stream channel. These disturbances can significantly change the features of stream sediments, and reducing water quality. According to Ripley [17], higher sediment concentrations increase the turbidity of natural waters, and reducing the light available to aquatic plants for photosynthesis. Additionally, increased

sediment loads can smother organisms in streams and oceans, eliminating essential food sources for predators and decreasing available habitat for fish to migrate and spawn [13]. Again, higher sediment loads can also decrease the depth of streams, resulting in greater risk of flooding during times of high stream flow [18].

Figure 3: disturbance of a water body at Abonko

Land reclamation which according to Powter [19], refers to as the process of reconverting disturbed land to its former or other productive uses; has been rejected by clay harvesters in Ghana. Normally, mined lands could be reclaimed to support farming and other agricultural activities to the benefit of mankind. The American federal Surface Mining Control and Reclamation Act (SMCRA) [20] stated that, there should be a better restoration of strip-mined lands, especially where mines replaces prime farmland. They outlined that the following could be adopted to reclaim mined exploited lands. They include; increasing soil fertility, rebuilding soil structure, management of soil pH, re-establishing nutrient cycles, top soil management as well as controlling the influence of soil erosion on reclaiming land. In Ghana, most clay harvesters normally abandon the harvested site after their harvesting activities without any effort to reclaim it. Therefore, the main purpose of the study is to find out the economic and environmental impact of clay harvesting at Abonko in the Mfantsiman West District of Central Region, Ghana. The study was limited to taking of photographs (pictures) of the clay harvesters during the harvesting period. They were afraid the photographs could be used for possible arrest and prosecution by the Bureau of National Investigation (BNI) in the near future. However, that did not affect the responses to interviews conducted and questionnaire used to solicit information for the study.

2. Materials and Methods

The study was conducted at Abonko in the Mfantsiman West District of Central Region, Ghana. The major occupation of inhabitants is clay harvesting and pottery. The industry engages mostly indigenes who use clay to manufacture products such as brick productions, pots, earthen wares, cups, bowls and some important items; while others also engage in clay harvesting as a major livelihood.

The target population was the residents who engaged in production of clay items for sale and clay harvesters. For the purpose of the study, ten (10) people were randomly selected from four sampling sites making a total sampling size of forty (40) for the study. The main instruments used for collecting data were questionnaire, interviews, and direct observation of site and community base response survey. The results from the study were analyzed and interpreted in the form of charts, photographs, tables and percentages.

3. Results and Discussions

Table 1: Educational level of the respondents

Educational level	Number of respondents	Percent (%)
No formal education	8	20
Primary education	8	20
Junior high school education	18	44
Senior high school education	3	8
Tertiary education	3	8
Total	40	100

The table above shows the educational level of the respondents during the study. Although majority of them had attained less education but those who claimed to have Junior High School (JHS) education could hardly write or read. This supposes that over eighty four percent (84%) of the total respondents could be described as secondary literates and illiterates. As a result, the effects of their activities to the environment and its inhabitants are least known by these clay harvesters which Sterling [21] admitted that, an ecologically literate society would be a sustainable society which does not destroy the natural environment on which they depend. On the other side, an ecologically illiterate society can consciously or unconsciously undertake activities that can have adverse effects on the environment. The respondents who attained education below Senior High School (SHS) could scarcely appreciate the effects of the clay harvesting on the ecosystem and thus negatively impact the environment as opined by Capra [22] , that understanding the principles of organization of ecosystems and their potential application to understanding how to build sustainable human society, combines the sciences of systems and ecology in drawing together elements required to foster learning processes toward a deep appreciation of nature and our role in it. Again, Capra [23] stated that in the coming decades, the survival of humanity will depend on our ecological literacy - our ability to understand the basic principles of ecology and to live accordingly. This

suggests that eco-literacy must become an important part of education at all levels – from primary up to tertiary education.

Table 2: Economical purpose of harvesting clay and clay products

Criteria	Number of respondents	Percent (%)
Main source of income	31	77.5
Additional source of income	7	17.5
None of the criterion	2	5.0
Total	40	100.0

In order to access the economical aspects of clay harvesting and sales of clay products, the respondents were asked to declare their sources of income. This has been presented in table 2 above. Out of the forty (40) respondents, 31 representing 77.5% stated that they engaged in clay harvesting and clay products as their main source of income. This is an indication that clay business is very lucrative in the community and serves as the main source of livelihood. It could also imply that the lucrative nature of clay business has affected the level of education in the area as people might engage in clay business at the expense of schooling. Seven (7) respondents constituting 17.5% admitted that the clay business served as an additional income to their livelihood. It suggests that these people knew the consequential effects of clay harvesting and as such would not like to take clay business as their main source of income. The remaining two (2) forming 5.0% of the respondents could not state as either main or additional source of income. It supposes that they could be assisting others in harvesting clay without knowing its effects on the environment.

Figure 4: brick production at Abonko

Table 3: Contribution of clay business to the benefit of the society

Payment of taxes	Number of respondents	Percent (%)
No	28	70.0
Yes	12	30.0
Total	40	100.0

Table 3 indicates the contribution of clay business to the benefit of the society. Twenty-eight (70%) of the respondents stated they paid no taxes to the society. Twelve (30%) of the respondents said they paid taxes, even though not enough to the assembly. It could be concluded that majority of the people engaged in the clay business did not pay taxes either to the assembly or the community. This could affect the assembly's revenue generation and developmental projects in the Abonko township. Again, it suggested that the indigenes of Abonko did not benefit from most of the clay business activity; and that it was only those who engaged in the mining of clay business that enjoyed the benefits or their booty at the detriment of the people of Abonko.

Table 4: Clay harvesting sites closer to water bodies

Response	Number of respondents	Percent (%)
Agree	37	93.0
Disagree	3	7.0
Total	40	100.0

Table 4 highlights respondents' agreement about clay harvesting sites getting closer to water bodies. Thirty-seven (93%) of the respondents agreed that clay harvesting sites were closed to water bodies. Only 3 (7.0%) of the respondents disagreed that the clay sites were closed to water bodies. Clay harvesting either by opencast or by shaft methods has detrimental effects on water bodies; and thus causes a reduction in the overall water

quality in and around the harvesting areas. The major effect of clay harvesting on water bodies is the change of water colour due to the dissolved clay particles in the water. Since clay is made up of different colours such as red, blue, black and grey, water bodies that are affected also assume such colours as shown on the next page.

Figure 5: affected water bodies in Abonko.

Davis [15] opined that mines, both active and inactive, are potential water contamination sources. Additionally, Freeze and Cherry [16] stated that drainage of materials from abandoned mines can act as ground water contamination source for years after mining operations have stopped. According to the indigenes of the community, the stock piles gradually drain to the nearby streams after rainfall which is in connotation to what Mason [18] mentioned. The harvesting sites were closed to water bodies; and digging to relatively low depth usually hits the water table and causes underground water to drain into the harvesting pits and overflows to disturb the nearby residence. The streams on the other hand easily dry up during dry seasons as a result of reduced volume of water underground.

Figure 6: affected residential buildings in Abonko.

In effect, harvesting of clay minerals close to water bodies has overwhelming effects on the lives of both plants and animals including humans in and around the locality.

Table 5: Clay mined lands have been reclaimed

Response	Number of respondents	Percent (%)
Agree	2	5.0
Disagree	38	95.0
Total	40	100.0

Table 5 indicates respondents' agreement as to whether clay mined lands have been reclaimed. Thirty-eight (95.0%) of the respondents believed that the harvested lands had not been reclaimed while 2 (5.0%) agreed that there had been some form of reclamation on the harvested land.

Figure 7: clay harvesting unclaimed land at Abanko

Most of the respondents explained that there was no need for any reclamation because such lands are not usually cultivated and that the time of reclamation could be used to harvest a lot of clay. The harvesters' knowledge about land reclamation is contrary to the reports of Alfred and Tuley [24], that environmental hazards posed by mining activities can be reduced by adapting best mining practices such as land reclamation after mining. Because land reclaiming activities such as those outlined by the SMCRA [19] have not been adopted by the harvesters in the area, physical and chemical properties of the soil has been compromised completely. Organic manure can be added to reclaiming land to improve the soil physical properties. Jordon et al [25] stated in their work that an organic amendment can be adopted by adding materials such as composted green waste or manure,

woodchips, biosolids, and others to improve soil structure, provide a slow-release fertilizer and adjust the water holding capacity. Again, Smith et al [26] posited that, addition of woodchips to bare soils helps to increase establishment and growth of plants. At Abonko, a large land on which clay has been harvested has been rendered unproductive and shows how valuable plots of land have been wasted in the locality. The uncontrolled digging and abandoning of pits can cause destructions of land beyond economic and technical reclamation. For instance, agriculture in this area has been seriously affected as a result of deep clay-harvested pits. This suggests that after the land has been reclaimed, varieties of crops can be cultivated to enhance yields.

According to the members of the community, because clay harvesting is done by open pit to appreciable high depth, there had been several instances that domestic animals when fall into such high depths are found dead and rotten polluting the air circulating the immediate environment. Water from the harvesting pits stagnate the area and serves as a source of breeding sites for mosquitoes. This affirms Wayne's [27] assertion that permanent swamps are important source for mosquito. Nearness of clay harvesting pits to the residential areas has increased the breed of mosquitoes in the area resulting in an increase in the outbreak of malaria in the community. It is therefore not surprising that malaria tops all the diseases reported in the district, according to the district health directorates, on the incidence of diseases in the district, as gathered from the District Health Management Team (DHMT) [28], Malaria topped the list with 1, 718 cases constituting 27.8% of all reported cases. McMahon and Remey [29] reported that unprotected pits, for example, during the rainy seasons, form breeding grounds for disease vectors such as housefly and mosquitoes which are the agents that spread water borne diseases and malaria.

4. Conclusions and Recommendations

Based upon the analysis of the results from the research**,** it was found out that a greater number of the respondents engaged in clay harvesting as their livelihood. The environmental consequences far outweigh the economical benefits of clay harvesting at Abonko. Ninety-five percent (95.0%) of the respondents harvest clay near residential areas and on farmlands which as a result made food foodstuffs very expensive in the locality. Because clay mining has not been properly regulated by mandatory agencies like Environmental Protection Agency (EPA), most water bodies in the community have been polluted as a result of clay harvesting. Huge agricultural farmlands have been destroyed and because there is no training and supervision of their work by EPA, there has not been land reclamation after clay harvesting. Most of the respondents have low educational background and therefore have little knowledge about environmental degradation. It is therefore recommended that traditional rulers should ensure that clay harvesting in their localities should not be done close to drinking water source since such water bodies could easily be polluted. The EPA should intensify their supervisory role at the clay mining sites in these areas to prevent the outbreak of diseases in Abonko. There should be District Bye-Laws put in place to ensuring land acquisition for clay harvesting as well as reclaiming the used land after the harvesting periods. Government should give financial support to research institutions, polytechnics, and the universities to find solutions to the problems associated with clay harvesting in Abonko and other parts of the country where clay harvesting is predominant. Periodically, educational programmes should be organized for clay miners in the community by the government through the district assembly to educate them on the impacts of indiscriminate clay harvesting on the environment so that clay miners become conscious of their activity to

the environment. There should be proper mechanism to organize clay miners into small scale industry and become suppliers of clay to industries, institutions, and schools offering ceramics so that government can get tax revenue from the clay harvesting activity to develop the community and the country as a whole.

Technically, clay should be harvested traditionally or locally in cyclical form so that the first area of harvest can be refilled naturally while harvesters move to different area in a serpentine order. By this way, the area would continue to have clay and the good serene environment with well filtered water even if the land is sloppy.

Again the miners can take it upon themselves to plant trees such as teak and acacia seedlings at the already mined areas to give the sites new environmental value and economic value in a few years to come. for instance, the teak trees after 15years can be used for electricity poles and for furniture design purposes which is very expensive and difficult to come by in this part of the world.

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References

[1] W. E. Worrall. Clays and Ceramic Raw Materials (2nd Edition). New York: U.S.A, Elsevier Applied Science Publishers, 1986.

[2] C. F. Speight and J. Toki. Hands in Clay (4th Edition). New York: U.S.A, McGraw-Hill Companies, 2000.

[3] Shaikh and Wik. “The Role of Clay Minerals in the Ceramic and Paper Industries”. Nordic Symposium Clay Minerals- Modern Society, Uppsala (Sweden), 20-21 Nov. 1986.

[4] H. H. Murray.” Overview of Clay Mineral Applications”. Applied Clay Science. Vol. 5, pp.379-395. 1991.

[5] Bi-Annual Journal of the Building and Road Research Institute (CSIR), Ghana. Vol.9, Jan-Dec. 2005.

[6] S. G. Ampian. “Clays In: Mineral Facts and Problems”. Washington, DC, US Bureau of Mines, Bulletin 675 Pretoria, South Africa and University of Zimbabwe, Geology Department: Harare, Zimbabwe, 1985, pp. 1- 13.

[7] F.C Okafor. "Rural Development and the Environmental Degradation verse Protection": In P. O. Sada and T. Odemerho (Ed.). Environmental Issues and Management in Nigerian Development, 2006, pp. 150-163.

[8] K. Fedra, L.Winkelbauer, and V. R. Pantulu. "Systems for Environmental Screening". An Application in the Lower Mekong Basin. International Institute for Applied Systems Analysis. A-2361 Laxenburg, Austria, 2005, p.169.

[9] J. C. Williamson and D.B. Johnson. "Microbiology of soils at opencast sites II. Population transformation occurring following land restoration and the influence rye grass/fertilizer amendments". Journal Soil Science Vol. 42, pp. 9-16. 1991.

[10] M. H. Wong. "Ecological restoration of mine degraded soils, with emphasis on metal contaminated soils". Chemosphere 50, 2003, pp.775-780.

[11] A. S. Sheoran, V. Sheoran and P. Poonia. "Rehabilitations of mine degraded land by metallophytes". Mining Engineers Journal 10 (3), pp. 11-16, 2008.

[12] J. P. Haris, P.Birch and K. C. Short. "Changes in the microbial community and physio-chemical characteristics of top soils stockpiled during opencast mining". Soil Use Management 5, pp. 161-168, 1989.

[13] S. W. Johnson. "Effects of Submarine Mine Tailings Disposal on Juvenile Yellow fin Sole (Pleuronectes asper): A Laboratory Study". Marine Pollution Bulletin Vol. 36 (4). 1997

[14] R. Davies, R. Hodgkinson, A.Younger and R. Chapman. "Nitrogen loss from a soil restored after surface mining". Journal of Environmental Quality 24, pp. 1215-1222. 1995.

[15] S. N. Davis. Hydrologeology. New York. NY. John Wiley and Sons. 1966. p. 511.

[16] R. A. Freeze and J. A. Cherry. Groundwater. Englewood Cliff, NJ. Prentice Hall: 1979, p.605.

[17] E. A. Ripley. Environmental Effects of Mining. Delray Beach, Florida: St. Lucie Press. 1996.

[18] R. P. Mason. "Mining Waste Impacts on Stream Ecology". In C. D. Da Rosa (Ed.). Golden Dreams, Poisoned Streams, How Reckless Mining Pollutes America's Waters and How We Can Stop It. Washington, DC: Mineral Policy Center. 1997

[19] C. Powter. "Glossary of Reclamation and Remediation Terms Used in Alberta". Symbols in Sub-Sahara Africa. 4. pp. 205-230. 2002

[20] "The 1997 American Federal Act for Surface Mining Control and Reclamation (SMCRA, 1997)". Available: http://en.wikipedia.org/wiki/Surface_Mining_Control_and_Reclamation_Act_of_1997. [

02/08/2015].

[21] S. Sterling. "Whole Systems Thinking as a Basis for Paradigm Change in Education", PhD paper, University of Bath. 2003.

[22] F. Capra. "Ecological literacy". Available:

http://en.wikipedia.org/wiki/Ecological_literacy#cite_note-4. 1997. [30/10/ 15].

[23] F. Capra. "The Web of Life", Harper Collins. 1995

[24] M. T. Alfred and P. Tuley. "Landforms, Soils, Climate and Vegetation on the Jos Plateau". Land Resource Development Centre (LRDC) Miscellaneous Reports. 153 (1). 1974.

[25] F. L Jordan, M. Robin-Abbot, R. M Maier and E. P. Glenn. "A comparison of chelator-facilitated

metal uptake by a halophytes and a glycophyte". Environment Toxicology Chemistry 21, pp. 2698-2704. 2002.

[26] J. A Smith, G. E. Schuman, E. J. Depuit and T. A. Sedbrook. "Wood residue and fertilizer amendment of bentonite mine spoils". I. Spoil and general vegetation responses. Journal of Environmental Quality14, pp. 575-580. 1985.

[27] J.C. Wayne. Controlling Mosquitoes around the Home. The State University of New Jersey, RUTGERS. 2013.

[28] "The Mfantsiman West District Assembly Health Session". Available:

http://mfantsimanwest.ghanadistrict.gov.gh. [20/10/15].

[29] G. McMahon and F. Remey. "Large Mines and the Community". Tanzania. IDRC Publishers, 2001, p.335.