ENVIRONMENTAL IMPACT OF GYPSUM MINING IN SOME SELECTED COMMUNITIES OF FIKA LOCAL GOVERNMENT AREA OF YOBE STATE, NORTHEASTERN NIGERIA

Jazuli Aminu Ahmed[1] and Moisule Abubakar Moigonga[2]
[1]*Federal Ministry of Works Nigeria*
[2]*UNICEF, Yobe Nigeria*
Email: jaznaff@gmail.com

ABSTRACT

This study examined the nature of mining operations, the extent of environmental degradation caused by mining activities and the effect of mining on other human activities. Data was sourced using observation, focus group discussion and direct measurements of the diameter and depth of thirty (30) pits from the three mining locations in Fika Local Government Area. The data was analysed using descriptive statistics and showed average pit diameter and depth for Gashuwa is M±SD (1.16 ± 0.05) and (8.8 ± 3.25), Garin Ari has M±SD (1.16 ± 0.05) and (11.40 ± 3.77) while that of Turmi is M±SD (1.16 ± 0.06) and (12.90 ± 3.60). Ubiquitous mine pits and mounds of overburden dumps are the basic indicators of landscape degradation at all the mine sites. Soil erosion and land subsidence observed. Mining activities have also encroached upon other land use activities such as crop cultivation, grazing and forestry. The environmental impact of gypsum mining can be mitigated through increased level of awareness of environmental hazards among inhabitants; provision of tarred road to stop encroachment on agricultural land by heavy trucks and Government should enforce existing regulation on reclamation of mine site.

Keywords: Focus Group Discussion (FGD), Degradation, Gypsum

INTRODUCTION

Mining activities contribute significantly to the wellbeing of citizens by providing employment and income, it may in some cases, contribute to increased poverty (Ross, 2001a). This is because of the low levels of employment in the sector, use of mostly imported technology, high market volatility of minerals, competition with agricultural sectors, and institutional corruption and mismanagement (Sideri, 2004). In some cases, mining has provided jobs in an otherwise economically marginal area (Redwood, 1998). However, typically these jobs are limited in number and duration. In addition, communities that come to depend on mining to sustain their economies are especially vulnerable to negative environmental and social impacts, especially when the mine closes. Mining tends to raise wage levels, leading to displacement of some community residents, farming activities and existing businesses, and elevated expectations (Kuyek and Coumans, 2003). Mining may also trigger indirect negative social impacts, such as alcoholism, prostitution, and sexually transmitted diseases (Miranda, Hanendez and Yerena, 1998). Developing countries often seek to exploit mineral resources as a way of providing much needed revenue. Mineral wealth is part of a nation's natural capital and the more capital a nation possesses the richer it becomes (Davis and Tilton, 2003). Papua New Guinea receives almost two thirds of its export earnings from mineral deposits, diamond mining accounts for

ISSN: 2277-0097

approximately one third of Botswana's GDP and three quarters of its export earnings (Govt. of Papua New Guinea, 2002). Mining activities provide employment opportunities to both skilled and unskilled labour as such citizens living in a community take part in it because of the huge amount of income accruing from it. By nature, mining involves the production of large quantities of waste, in some cases contributing significantly to a nation's total waste output. Disposing of such large quantities of waste poses tremendous challenges for the mining industry and may significantly impact the environment. The impacts are often more pronounced for open-pit mines than for underground mines, which tend to produce less waste. Degradation of aquatic ecosystems and receiving water bodies, often involving substantial reductions in water quality, can be among the most severe potential impacts of mining (Matthews, 2000). The above are the general problems of mining which this project seek to address. Whether mining gypsum in selected Communities of Fika Local Government Area of Yobe State is associated with all these problems is going to be the outcome of this research work.

Gypsum is a naturally occurring mineral that is made up of calcium sulfate and water ($CaSO_4$+$2H_2O$) that is sometimes called hydrous calcium sulfate. It is the mineral calcium sulfate with two water molecules attached. By weight it is 79% calcium sulfate and 21% water. Gypsum has 23% calcium and 18% sulfur and its solubility is 150 times that of limestone, hence it is a natural source of plant nutrients. Gypsum naturally occurs in sedimentary deposits from ancient sea beds (Summer, 1989). Gypsum is a rock like mineral commonly found in the earth's crust, extracted, processed and used by Man in construction or decoration in the form of plaster and alabaster since 9000 B.C. Plaster was discovered in Catal-Huyuk in Asia in an underground fresco, and in Israel Gypsum floor screeds were found from 7000 B.C. During the time of the Pharaohs, Gypsum was used as mortar in the construction of the Cheops Pyramid (3000 B.C.). In the middle ages and the renaissance, decorations and artistic creations were made of plaster. Since then, the ranges of construction-related uses have continued to multiply (Living with Gypsum). Gypsum has been known for centuries and is one of the oldest building materials in the world. The earliest use of gypsum was in Anatolia around 6000 B.C. Later, in about 3700 B.C., gypsum was used on the interiors of the great pyramids in Egypt. Gypsum is found in every continent of the world and is one of the most widely used minerals (Olson, 2001).The environment is integrated and its components are linked by dynamic processes. We cannot use or affect any part without affecting some other part" (Sideri, 2004) observed that the extraction of mineral in Nigeria, especially by the open cast process has left injurious effects on the land surface. The most widespread destruction of the rural landscape according to him caused indiscriminate quarrying of sand and laterite as well as gravel for road construction and for building purposes.

Mining operations have been envisaged by environmentalist and conservationist alike as causing some of the most devastating and far reaching consequence to the environment In this regard he also observes that the very process of mining fossil fuel and minerals defaces the land with great scars and pits, destroys ecosystems and bring on many undesirable side effects such as water pollution and the disturbance of hydrolic systems. In addition he also noted that apart from causing land shortage for farming in the area and a decline in soil fertility due to over cultivation of the remaining land, mining has tended to increase the susceptibility of the soil to erosion.

It has increased the occurrences of landslides, mudflows and slumps. (Ripley, 1996).The removal of soil regolith and bedrock to extract minerals destroys entirely the preexisting ecosystems and habitants of plants and animals (Fryear, 1989). The waste minerals also create problems of pollution of air, water and soil. In underground operations, mining has unfavorable side effects on ground water resources. On the Jos Plateau, attempts to restore the vegetation and soils worked on began in the 1940s.This was done through the introduction of legislation which placed responsibility for restoration in the hands of both mining Companies and the colonial Government while the companies were expected to refill the mining pits after use. Government was expected to deposit top soil and humus on the refilled surfaces .None of these activities were however seriously tackled (Bukar,1997).In effect, despite the declared policy on land reclamation and soil generation, deforestation gets worsen as more and more land is being taken over by mining. Nigerian Mining corporation report of 1993 for cement Manufacturers Association of Nigeria indicates the estimated reserve which shows that the best gypsum localities are Nafada and Fika and that the largest known Nigerian Gypsum resources are mainly found in the North- Eastern Nigeria (EL-Nafaty and Baba 1995). The exploitation of the Nigerian deposits is mostly carried out by open pit methods due to the localized character of deposits. The simple technology involved and economic considerations which include the low ratio of overburden to mineral in relation to the surface area of the mine .At the end of the operation, however, there are large open pits, earth dumps and voids left.(El-Nafaty and Baba 1995).

STUDY LOCATION

The study area is located between Latitude 10.30" – 11.10N and Longitude 10.50-11.30 E. It is situated in the southwestern part of Yobe State, North eastern Nigeria. It shares geographical boundary with Potiskum and Nangere Local Government Areas to the North and Dambam Local Government Area of Bauchi State to the North West. It shares boundary to the South west with Nafada and Funakaye Local Government Areas of Gombe State. It also shares border with Gujba and Gulani Local Government Areas to the North east (Nafada sheet 109 North east).

MATERIALS AND METHOD

An observational study design was used to determine the nature of mining operation and the extent of environmental degradation caused by mining, while Focus Group Discussion (FGD) was used to determine the effect of mining on other Human activities. The sampling frame is the complete number of mining sites in the study area whether abandoned or active in order to gauge the environmental degradation impact as well as take measurements in the abandoned and active sites respectively. For the purpose of sampling for measurements of width diameter and depth of the mines, ten (10) samples were selected from each of the three locations, namely Gashuwa, Garin Ari and Turmi.

DATA COLLECTION

The required data for the study was collected largely from primary sources through field observation, measurement and use of focal group discussion. Measurements were carried out at the three mine sites where mining is currently taking place. These are Gashuwa, Garin Ari and Turmi mine sites.

The variables measured include the depths and diameters of the pits. The land area occupied by mining activities and the land area occupied by the overburden were observed. The proximity of farmlands, grazing lands and settlements to mine sites were also measured. The development of rills and gullies which normally indicate erosion problem are identified. To assist in the collection of data, research assistance was employed. The assistants possess a basic knowledge of Geography and can speak the local languages namely Karai Karai and Bolewa.

Field Observation

This involved the critical observation of the nature of mining employed in the area and also the extent of physical destruction that can physically be seen on the mine sites. The ubiquitous mine pits and mounds of overburden dumps are the basic indicators of landscape degradation at all the mine sites. The effect on the movement of heavy trucks used in the conveyance of the gypsum from the mine sites to the main road was also observed.

Measurement

Thirty (30) pits from the three selected mine sites were systematically selected. The variables measured include surface diameter, average vertical depths of the mine pits.

Focus group Discussion

Four Focus Group discussions were conducted. One with the Community Leader of Turmi being the most senior title holder amongst the three Communities hosting the mine sites and some of his wards head present with him at the time of our visit. Three FGDs were conducted at the three mine sites with the miners on duty .The discussions were aimed at knowing the nature and effect of the mining on the land surface and other land use activities such as farming, grazing.

DATA ANALYSIS

The data was analyzed using descriptive statistics of the mean, range, standard deviation and co-efficient of variation of the pit horizontal depths and diameters. The details of the result were presented in a tabular form.

RESULTS AND DISCUSSION

The Nature of Mining Operations

The physical nature of mineral deposit and the surrounding rock, the shape and structure of the ore deposit determine the method of extraction to be used. However, the actual decision by a particular method is primarily determined by the depth of overburden that overlies the deposit. In the study area, gypsum was found to exist at depth of 3 meters and extended vertically up to about 20 meters. The method of extraction employed is the surface type which simply involves the removal of overburden and extraction of the gypsum deposit in successive layers. Mining operation usually commence of vertical digging with pits possessing an average surface diameter of 1.16 meters. About 4 distinct layers of soil within the depth of 0-3 meters is usually encountered before arriving at the soil layer which indicates the existence or otherwise of the mineral deposit. The gypsum intercalation was observed to be bedded and generally more horizontally inclined. It varies in thickness from 1cm to 5cm.

Vertical digging is replaced by horizontal digging at a maximum depth of about 20 meters. Even at such length, the mineral is not exhausted but the pits are abundant due to shortage of oxygen or visibility problems. Horizontal digging involves the removal of the gypsum intercalation in four directions from the main pit at right angles to one another while leaving a series of pillars carved out of the minerals to support the roof of the working. This method of operation was observed to be wasteful as some substantial amount of the gypsum deposit is left behind in support pillars and roof. From the field survey, the miners reveal that a substantial percentage of the reserve mineral is left behind in the pits. The same types of tools are used by the miners in all the sites visited. Simple tools such as picks, shovels, diggers and head pans are employed. Other implement are rope and torchlight. The survey also reveals that there is no particular period of operations or rest at different times of the day and night. However, mining operation subside during the hot afternoons usually 12-3 pm and at the pick of the current insurgency late last year. Extraction activities during the night are relatively.

ENVIRONMENTAL DEGRADATION CAUSED BY GYPSUM MINING

Landscape Degradation

Ubiquitous mine pits and mounds of overburden dumps are the basic indicators of landscape degradation at all the mine sites. Table 4.1 shows the result of the analysis based on the information captured during the survey from 30 purposively selected pits (10 at each mine pit) gave an average surface diameter of 1.16 meters, and average horizontal depth of 11.03 meters.

In between these pits are dotted spots of earth mounds formed by the pilling of materials of overburden removed to expose the mineral deposit. It was found out from the miners that every pan of gypsum obtained an estimated of about 5 pans of waste and overburden rock has been excavated. These are just rough estimate but provide an insight on the level of degradation that take place. These open pits and overburden dumps form a bad land topography which also greatly disturbs movement of miners and of the minerals to the collection points.

Soil Erosion

Observation reveal that most mine pits get enlarged upon exposure to rainfall thereby developing into gullies. The thirty (30) mines studied showed that gullies of over 2.5 meters have developed on almost all the abandoned pits around the mine pits. This represents a significant percentage of the mine sites. The mounds of overburden also possess steep slope that are in some cases washed back into the pits. This eventually develops into gullies. The clearing of sites of all vegetal cover for mining operations exposes the bare soil to large micro climatic changes which alter the soil surface, making it more vulnerable to wind and water erosion. The removal of the root systems of plants which act as binding mechanisms also accelerates both wind and water erosion. The lack of protection or tree cover increases the speed and desiccating of wind to which valuable top soil is exposed. The cumulative effect of these mechanisms is the production of land surface where the regeneration of plant is difficult and further accompanied by a general decrease in the productivity of the ecosystem. In effect, deforestation accelerates desertification, threatening the continuous usage of these areas. Desertification is the process through which first, the plant cover, species diversity and primary productivity of arid and semi-arid ecosystems are drastically reduced (NEST, 1990).

Land Subsidence

Tunnels of up to 20 meters are sometimes dug by the miners to extract the mineral deposit. To support the roof of the tunnels, pillars carved out of the mineral are usually constructed. Although it is very rare, these pillars sometimes collapse as it happened a day to our field work visit at Garin Ari. Information from the miners indicates that over 15 trucks of gypsums were excavated from this particular pit that collapse in the last six months.

The Effect of Mining on other Land Use Activities

Gypsum mining is one of the activities that have come to compete with other human activities in the study area. These activities include farming, forestry and hunting. Prior to mining activities , the land area now under mining operations were used for various purposes amongst which include, farming, forestry, grazing and hunting according to focal group discussion conducted. From the discussion conducted about 30 percent of the area currently under mining operation used to be barren land characterized by little or no vegetation cover, rugged surface on which cultivation is almost impossible. As a result of these physical limitations, only few areas of the mine areas used to be cultivated in Gashuwa area. With the commencement of mining activities, marginal farmlands which use to exist in close proximity to the mine site have been abandoned. Yet mining activities have still encroached on to farmlands such that at all the mine sites, the distance to the nearest farmland is less than 100 meters. Thus the threat of further encouragement on to farmlands cannot be ruled out as long as mining activities continue. Farmlands have been affected by the mining related activities such as the regular flow of heavy duty trucks that use the untared roads. Due to the poor condition of roads, trucks often drive into farmlands to avoid getting stuck in mud or sand.

SUMMARY AND DISCUSSION

Mining Activities

The method of extraction of gypsum deposits in Fika Local Government Area is primarily determined by the depth of overburden that overlies the deposits. The method was observed to be basically of the surface type which involves the removal of overburden and extraction of the deposit in successive layers. As mining advances, vertical digging is replaced by horizontal digging where by tunnels are dug at three to four directions from the main pit at right angles to one another while leaving behind series of pillars carved out of the mineral to support the roof of the tunnels. Simple implement such as diggers, picks and shovels are employed in the extraction activities and miners work under zero safety. The average depth of mine pits and diameter for Gashuwa is M±SD (1.16 ± 0.05) and (8.8 ± 3.25), Garin Ari has M±SD (1.16 ± 0.05) and (11.40 ± 3.77) while that of Turmi is M±SD (1.16 ± 0.06) and (12.90 ± 3.60)

Environmental Impact of Mining

Findings from the study show that mining has resulted in land degradation in the study area. The mounds of overburden dumps and ubiquitous open pits are the basic indicators of land disturbance at all the mine sites. The clearing of the vegetation cover has resulted to deforestation which has in turn initiated both wind and water erosion in form of rills and gullies.

Mining activities have also encroached upon other land use activities such as crop cultivation, grazing and forestry. It was observed that all mine pits are abandoned after operations. Thus no form of reclamation takes place at all the sites.

CONCLUSION

Gypsum mining is a major economic activity in Fika Local Government area of Yobe state, Nigeria, apart from taking over agricultural lands, the abandonment of old mine sites without reclamation proves major environmental challenge in the area as vast lands deforested as exposed to erosion. The trend needs to be curtailed.

REFERENCES

Bukar Yagana (1997) Effect of Gypsum Mine on Southern Part of Fune Local Government Area. Unpublished M.Sc Dissertation Submitted to the Department of Geography. University of Maiduguri.

Davis, G.A. and J.E. Tilton (2003), "Should Developing Countries Renounce Mining? A Perspective on the Debate," Paper contributed to Extractive Industries Review (EIR).

El-Nafaty J.M. and Baba S. (1995). The Occurrence of Industrial Minerals Deposit In Yobe State .*Nigeria Research Journal of Science*, Vol no. 1: pp34-45.56

Fryrear, D.W. (1984), "Soil Erosion, Land Degradation, Desertification" in Land Management in Arid and Semi arid Areas, Geneva: WMOP P. 10.

Government of Papua New Guinea (GoPNG) (2002), "Fourth Quarter Bulletin: Annual Bulletin, 2001" PNG Department of Mining. Port Moresby, PNG: GoPNG.

Kuyek, J. and C. Coumans (2003), *No Rock Unturned: Revitilizing the Economies of Mining Dependent Communities*. Mining Watch Canada: Ottawa, Canada. Available online at: http://www.miningwatch.ca. Last Accessed September 6, 2003.

Matthews, (2000), *The Weight of Nations: Material Outflows from Industrial Economies* Washington, DC: World Resources Institute.

Redwood, J. (1998), "Social Benefits and Costs of Mining: The Carajás Iron

Ore Project, In G. McMahon (ed.) *Mining and the Community: Results of the Quito Conference*, Washington, DC: The World Bank, 1998.

Ripley, E.A. et al. (1996), *Environmental Effects of Mining*. Delray Beach, Florida: St. Lucie Press.

Ross, M.L. (2001a), *Extractive Sectors and the Poor,* Oxfam America: Washington, DC.

Ross, M. (2001b), "Natural Resources and Civil Conflict: Evidence from Case Studies," Paper prepared for the World Bank/UC Irvine Workshop on "Civil Wars and Post

Conflict Transitions," May 18-20, 2001, Irvine, CA.

Sideri, S (2004), *Mining for Development in the Third World: Multinational Corporations, State Enterprises and the International Economy*. New York: Pergamon Press.

Summer,(1989) "Principle of Gypsum Use as a Soil Amendment" Agronomy Division. The University of Georgia. Publication MP 373, Oct. 1989. Yobe State Diary (2010). Published by the Ministry of Information- Damaturu Yobe state.

Figures 1: Map of study area

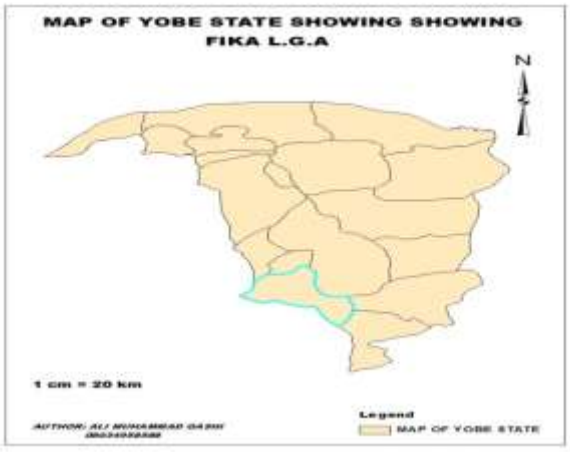

Table 1: Measurement of pit diameter and depth of samples at the different locations.

Pit No	Gashuwa		Garin Ari		Turmi	
	Pit Diameter	**Pit Depth**	**Pit Diameter**	**Pit Depth**	**Pit Diameter**	**Pit Depth**
1	**1.2**	**3**	**1.1**	**6**	**1.2**	**18**
2	**1.2**	**4**	**1.1**	**11**	**1.2**	**10**
3	**1.1**	**12**	**1.1**	**14**	**1.2**	**14**
4	**1.05**	**7**	**1.2**	**10**	**1.2**	**7**
5	**1.2**	**8**	**1.2**	**13**	**1.1**	**13**
6	**1.2**	**11**	**1.2**	**6**	**1.1**	**8**
7	**1.2**	**9**	**1.1**	**12**	**1.0**	**15**
8	**1.1**	**12**	**1.2**	**9**	**1.2**	**13**
9	**1.2**	**11**	**1.2**	**16**	**1.2**	**14**
10	**1.2**	**11**	**1.2**	**17**	**1.2**	**17**

Table 2: Statistical distribution of variables mean, standard deviation range and co-efficient of variation.

Pit parameters	N	Range	Mean	Std. Deviation	C of Var.
Gashuwa Pit Diameter	10	0.15	1.16	0.057	0.049
Gashuwa Pit Depth	10	9.00	8.80	3.259	0.370
Garin Ari Pit Diameter	10	0.10	1.16	0.051	0.445
Garin Ari Pit Depth	10	11.00	11.40	3.777	0.331
Turmi Pit Diameter	10	0.20	1.16	0.069	0.602
Turmi Pit Depth	10	11.00	12.90	3.604	0.279

Reference to this paper should be made as follows: Jazuli Aminu Ahmed & Moisule Abubakar Moigonga (2015), Environmental Impact of Gypsum Mining in Some Selected Communities of Fika Local Government Area of Yobe State, Northeastern Nigeria. *J. of Environmental Sciences and Resource Management,* Vol. 7, No. 2, Pp. 115 – 123.