

Review

Environmental effect of mineral exploitation in Nigeria

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The three stages of mineral development, viz exploration, mining and processing, have caused different types of environmental damages, which include ecological disturbance, destruction of natural flora and fauna, pollution of air, land and water, instability of soil and rock masses, landscape degradation and radiation hazards. The environmental damage has in turn resulted in waste of arable land, as well as economic crops and trees. Since much of the damage is inevitable, if the minerals must be developed, both the government and the mineral industry must be involved in taking precautionary and remedial measures that can minimize the ill-effects of mineral development. Emphasis should shift from waste disposal to waste minimization through sorting, recycling of reagents and water. While the government should provide the regulatory legislation with appropriate sanctions, the mineral-producing companies are expected to carry out mandatory precautions, remedies or compensation for the damage done.

Key words: Minerals, rock, mining, environmental degradation.

INTRODUCTION

Exploitation of mineral resources has assumed prime importance in several developing countries including Nigeria. Nigeria is endowed with abundant mineral resources, which have contributed immensely to the national wealth with associated socio-economic benefits. Mineral resources are an important source of wealth for a nation but before they are harnessed, they have to pass through the stages of exploration, mining and processing (Adekoya, 2003; Ajakaiye, 1985). Different types of environmental damage and hazards inevitably accompany the three stages of mineral development. It is the purpose of this paper to present in a nutshell the negative effect on the environment of the activities involved in harnessing the minerals in Nigeria. An attempt will also be made to examine the possible precautions and remedies that can be applied in order to mitigate the effect of adverse environmental impact of mining activities.

Table 1 shows the minerals deposits that are currently being exploited in Nigeria. Some of the minerals, notably, cassiterite (tin), columbite, tantalite, wolframite, lead, zinc, gold and coal have been exploited on a commercial scale since early part of the last century and have made significant contributions to the revenue and socio-econo-

mic development (Kogbe and Obialo, 1976). Other minerals like monazite, xenotime, zircon, thorite and molybdenite have also been produced in lesser quantities and exported. Relatively more recently, oil and gas (starting from 1957), limestone, marble and rock aggregates have been playing an increasing role in the national socio-economic development and growth because they generate appreciable internal revenue and/or foreign exchange earnings. They have, in fact, overshadowed other economic minerals by generating over 90% of the export earnings, more than 50% of the national revenue.

At present, many of the minerals are at different levels of exploitation as shown in Table 1. To a large extent, the scale of operations involved in exploration, mining and processing of a mineral determines the intensity and extent of environmental degradation. Thus in general, a greater damage is witnessed in the localities where tribute workers do only manual winning of minerals. For example, large-scale mining of tin and associated minerals in the Jos Plateau has resulted in a high degree of degradation of arable land, vegetation and landscape, as well as other environmental problems. Other localities affected by large-scale environmental damage are the Niger Delta as a result of oil and gas exploration and exploitation; Sagamu, Okpilla, Ewekoro, Ashaka and Gboko owing to quarrying of limestone and the establishment of Portland cement manufacturing company; and in Enugu as a result of coal mining.

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Table 1. Minerals currently being exploited in Nigeria.

S/NO	Mineral Name	Locality	Current Level of Exploitation
1.	Iron	Itakpe	L
2.	Tin	Jos Plateau, Nassarawa	M,S,M
3.	Niobium/Tantalum	Jos Plateau, Saki, Idiko-Ile, Oro	Won-as-by-product of tine mining
		Jos Plateau	-ditto-
4.	Monazite	Jos Plateau	Dormat
5.	Xenotime	Itagunmodi, Bimin Gwari, Dangbala	S
6.	Gold	Ishiagu, Enyigba, Ameka, Ameri	Presently Dormant
		Ishiagu, Ameka, Ameri	M, Won as by-product of lead
7.	Lead	Ishiagu, Enyigba, Ameka, Ameri	(galena) mining
8.	Silver	Ashaka, Ewekoro, Nfamosing, Nkalagu,	Won as by-product of lead
9.	Zinc	Kalambaina, Igarra, Dangbala, Ikpeshi, Atte, Okpilla	mining
10.	Limestone	Burum, Igbetti, Igarra, Jakura, Kwakuti, Okpilla, Ikpeshi	L
		Gwoza, , Warake	
		Wurno, Fika area Ikpeshi, Warake, Azara	M, M (Presently dormant), L
11.	Marble	Omi Adio, Ozubulu, Naragua, Kano, Ikorodu, Lagos, Ire	M
		Badagry, Igbokoda, Ughelli	S
12.	Feldspar	All part of the Federation	S
13.	Gypsum	All parts of the Federation	L
14.	Barytes	-ditto-	L
15.	Clay	Ijero-Ekiti, Jos Plateau, Saki, Falansa, Iyano Church	M,S
		Ijero-Ekiti	L, M, S
16.	Glass sand	Jos Plateau, Akwanga Area	-ditto-
17.	Construction sand	-ditto-	S (mainly illegal mining)
18.	Construction stones	Jos Plateau	S –ditto-
	Laterite	Enugu	S –ditto-
19.	Beryl	Niger Delta	S –ditto-
20.	Tourmaline		S –ditto-
21.	Sapphire		S –ditto-
22.	Ruby		L
23.	Topaz		L, M
24.	Coal		
25.	Oil and Gas		
26.			

L = Large scale exploitation; M = Medium scale exploitation;
S = Small scale exploitation.

On the other hand, the environmental damage caused by small-scale quarrying of laterite, clay, gravel and stone in numerous parts of the country by private entrepreneurs is less but more difficult to control. A special mention must be made of the environmental degradation caused by the illegal mining of gemstone. Because of the uncontrolled manner the illegal miners operate, a lot of damage is done to the environment by haphazard pitting and trenching of the ground in many areas. This results in a kind of

artificial bad land topography, which consequently renders the land impossible to cultivate for agricultural purposes.

Types of environmental damage

“Environment” as used in this paper has three components, namely, the sum total of external conditions in

Table 2. Environmental distribution of mineral pollution in Nigeria. (Aigbedion, 2005).

YEAR	LAND	SWAMP	OFFSHORE
2004	59	39	14
2005	33	28	15
2006	50	35	23

which organisms exist; the organisms themselves including the floral and faunal community; and the physical surroundings such as landforms. All these three aspects, which include various entities such as air, water, land, vegetation, animals including human, landscape and geomorphological features, historical heritage etc. are adversely affected one way or the other during the course of mineral development.

Air, land and water pollution

Varying degrees of pollution of air, water and land occur in the course of mineral development depending on the stage and scale of activities attained. While only minor pollution occurs during mineral exploration, more intense air and water pollution emanates from the exploitation stages, particularly if carried out on a large scale. In Nigeria, the greatest pollution effect comes from a large-scale exploitation of petroleum, limestone and rocks used in the construction works (Unesco-Mab, 1995).

In the oil-producing areas of the country oil spillage of differing intensity resulting from burst pipelines, tanks, tankers, drilling operations, etc. is a common phenomenon. It causes water and land pollution with grave consequences on both aquatic and terrestrial life. For example, fishes living in surface waters are killed as a result of which fishermen in such areas have lost their means of livelihood. Groundwater pollution has made it impossible for the indigenes of the affected Niger Delta areas to obtain potable water. Well water is almost invariably covered with a thin oil film.

So far over 80% of the gases associated with the Nigerian oil are flared off. Thus, many large red flames burning endlessly are a very common sight in the Niger Delta, the oil province of Nigeria. The flaring results, among others, in increasing CO₂ and CO discharge into the atmosphere thus causing disequilibrium or imbalance in the air that supports life. A possible enhancement of earth warming through "green-house effect" can also occur.

Large volume of dust from the cement factories and mining operations in the Nigerian limestone quarries are discharged daily into the air. Similarly a lot of air-borne particulate matters are generated by the numerous stone-crushing industries in the country. When the air is laden with such dust, it causes health hazards for some people. For example, pollution studies around Sagamu and Ewe-

koro cement works in Ogun State have shown that several people are suffering from eye pain, and asthmatic attack due to the dust-laden air that prevails within a few kilometers radius of the factories (Aigbedion, 2005).

Damage of vegetation

Vegetation in form of natural forest or crop plantation is usually the first casualty to suffer total or partial destruction or degradation during the exploration and exploitation of minerals in a locality. The vegetation damage is more extensive at the time of mine development and mining operations and is more expensive when crop plantation is affected. This particular problem is perpetually caused by violent confrontation between the indigenes of the Niger Delta and the oil companies. In the Niger Delta, where oil spillage occurs, the vegetation, especially the surface feeders such as the palm tress, is often degraded.

Recent environmental impact studies of limestone mining and cement industry in Sagamu have revealed a declining kola nut output from the plantations within a few kilometers radius of the cement factory (Aigbedion, 2005; Adekoya, 2003). This phenomenon is most probably associated with dust pollution as plenty of dust is discharged into the air mainly from the cement factory. The particulate matter eventually gets deposited on the kola-nut leaves and flowers as well as the soil supporting the plants. The overall effect of this is that the photosynthetic and fruiting ability of the kolanut tree is impaired with a consequent decrease in kolanut production.

Pollution can be grouped into different environmental situation in mineral exploration/exploitation areas (Table 2):

It can be observed from data collected for three years, that most of the pollution occurs on the land with few offshore.

Ecological disturbance

Another adverse effect of mineral extraction and processing activities, which may not be immediately felt, is the disturbance of the ecosystem with possible adverse consequences on the floral and faunal community in general. For example, the deforestation of an area during the mine development may cause the elimination of some plants and the exodus of some animals that feed on such

plants or depend on them for cover, from the affected area. Similarly, the noise generated in the course of blasting, quarrying and crushing can also frighten away part of the fauna in a mining locality.

Oil spillage produces a devastating ecological disturbance in the oil-producing states as well as in areas where leakage occur due to natural breakage of oil pipe line or illegal bunkering (Aigbedion, 2005). The plants, animals, soils and water are affected. As mentioned earlier, the vegetation may suffer degradation and eventual death. Some of the animals, especially fish and other aquatic life, as well as small terrestrial animals particularly those that feed on fish or lower plants, may die for lack of food or from contamination with the oil spillage, which normally spread rapidly. The soil gets soaked in oil and water is covered with oil. Consequently the ecosystem suffers not only disequilibria but also pronounced degradation with dire consequences on the food chain (Adepelumi et al., 2006).

Degradation of natural landscape

A common negative effect of mining minerals from the earth's surface is the destruction of its natural landscape, creating open space in the ground and generating heaps of rock wastes that cannot be easily disposed off. These phenomena are amply demonstrated in several parts of Nigeria, where commercial mining or quarrying had occurred in the past or is currently taking place.

In the Younger Granite Province, especially the Jos Plateau, tin and columbite mining has resulted in the destruction in places of the scenic landscape which is replaced by unsightly large irregular holes and heaps of debris produced by the opencast method of mining (Brooks, 1974). The alteration of the landscape almost invariably creates a problem of erosion in the mining localities with the result that most of the opencast pits are filled with water. A similar situation exists in all the limestone and marble quarries in differing proportions at Ewekoro, Sagamu, Nkalagu, Gboko, Ashaka, Kalam-baina, Okpilla, Jakura, etc. In many localities, particularly near centres of heavy construction works (road and building), large granite and gneiss inselbergs with their delightful scenic view are now being pulled down to produce rock aggregates e.g. at Abuja, Abeokuta, Ibadan, Ilorin, Minna, Kaduna, Kano, Bauchi, etc.

In recent times, the search for gemstones in Oyo, Kwara, Edo and Ondo States by illegal miners have resulted in haphazard pitting and trenching of the Older Granites pegmatites that host the minerals, without regard to the mining regulations. At present, irregular holes and heaps of rock materials characterize the areas that have fallen victims of illegal miners. Notable examples can be found at Ijero, Ekiti State; Igbojaiye, Olode, Falansa and New Target in Shaki area. Oyo State; Iwo, Osun State, and Oro in Kwara State. The natural land-

scape in these areas is now replaced by a kind of bad land or hummock topography punctuated by irregular holes.

Geological hazards

Mining operations normally upset the equilibrium in the geological environment, which may trigger off certain geological hazards such as landslide, subsidence, flooding, erosion and tremors together with their secondary effects. Some cases of subsidence and instability associated with draining of oil and gas from the subsurface reservoir have been reported in the Niger Delta (Aigbedion, 2005; Adekoya, 2003). Similar subsidence has occurred in the Iva valley, Enugu area, as a result of coal mining. The subsidence led to diversion of water into the mines, which had to be pumped out at high cost (Kogbe and Obialo, 1976).

Minor earth tremors are generated due to blasting of rocks in various quarries. Villages and settlements in the neighborhood of the quarries have experience unpleasant earth movements when the rocks are blasted (Ajakaiye, 1985). Some buildings are damaged by developing cracks due to minor tremors occasioned by the incessant blasting of the rocks.

Socio-environment problems

Some socio-environmental problems are sometimes created as a result of certain peculiarity of the mineral industry. Since minerals are exhaustible and irreplaceable commodities, the life of a mine and, consequently, the mining activities in a place have a limited time. The stoppage of mining activities imposed by depletion of the available reserves often leads to migration of people from the mining areas to other places. This may result in the formation of "ghost towns", which are abandoned towns and previous bubbling mining communities. For example, Sofon Birnin Gwari was a town that once thrived on gold mining between 1914 and 1938 but was abandoned due to exodus of miners and prospectors to the Plateau tin fields in the early forties. Incidentally, the miners are currently returning to the Gwari area as a result of a new discovery of gold deposits in the place (Adekoya, 2003).

Radiation hazards

Exposure to natural radiations emitted by some radioactive minerals is a major source of health hazards. The radiation intensity increases when the minerals are concentrated. It has been established that some minerals such as monazite, pyrochlore and xenotime, which are obtained as by products of tin mining in the Jos Plateau, are radioactive. Because of lack of market, most of these

minerals, which were in form of concentrate, are abandoned in many previous mining sites on the plateau. Some of these sites had mining communities, which developed into villages where a high level of radiation has been recorded.

A few of such villages has been abandoned or nearly deserted because of the death of many people under mysterious circumstances. The mysterious deaths are now attributed to a high level of radiations released by monazite-rich sand used for building the houses the deceased lived in (Aigbedion, 2005).

Precautions and remedies for environment damage

In order to minimize the ill effects of mineral mining and processing, certain precautionary measures must be taken by both the government and the mining and processing companies. The government's role is to provide the legislation required to make it mandatory for the companies to practice all necessary precautions in their operations that will prevent or minimize environmental damage. Such legislation already exists in Nigeria as the Minerals and Mining Decree of 1999.

The new Minerals and Mining law has addressed, among others, the environmental conservation issues very seriously. Apart from stating unequivocally the conservation methods, which must be employed in mining and processing operations, the new law has not made sufficient provision of sanctions against those who fail to comply with the environmental protection regulations. There is the need to strengthen the new law with the following suggestions made by Adekoya (1995).

- (i) Mining companies should submit environmental restoration plans together with their application for either prospecting or mining lease of an area;
- (ii) Processing companies must install appropriate equipment, where necessary, for preventing or minimizing pollution;
- (iii) All large mining and processing companies are to prepare a prognosis of the possible environmental impact of their operations, as well as the technique for monitoring the impact for approval of the Mines Department before the companies can commence operation.

Since some damage to the environment is inevitable in the course of mineral exploitation, usually, the only option left is to apply some remedy to the damage. The remedy or compensation should depend on the type, extent and magnitude of damage, which can be permanent or redeemable in which case the damage effect fades away as the causative factor is withdrawn. The environmental impact of mining and processing activities can extend for many kilometers from the operation site. For example, the dust pollutants could spread up to a distance of more than 5 Km from the source.

Before any remedy could be applied to any environmental problem, there is need to assess or measure the magnitude of the problem. This can be done by direct measurements such as calculating the value of economic trees removed and changes in farm produce due to pollution; land, road and property reparation cost; water treatment cost; and the costs of treating diseases directly traceable to the environmental damage. However, direct measurements of environmental damage are not always possible because the damage may be intangible, subtle or even slow to appear (Brooks, 1974). Under such a situation the cost of providing an alternative environment or renewable resources elsewhere, if possible, can be considered.

A major issue concerning the remedy or compensation for environmental damage resulting from mining and processing activities is that those who bear the costs of the environmental damage are the people who live in the environment and not the producing companies. This case is well illustrated in Sagamu where blasting of limestone in the quarry and dust pollution from the cement works are causing incalculable damage to life, crops and buildings. Although the cement producing firm (West African Portland Cement Company) is the cause of the environmental problems, it is the Sagamu citizens who do not share in the company's profit that bear the reparation or replacement costs resulting from the adverse environmental effects (Adekoya, 2003).

The problem requires the intervention of government through appropriate legislation that can compel the mining/processing companies to internalize the reparation or replacement costs, which are so far borne by the people who live in the environment. Safe disposal of unavoidable waste in stable and aesthetically acceptable structure must be enforced through legislation.

Conclusion

Extraction and processing of mineral resources is the backbone of the national economy in many developed and developing countries of the world. However, the great danger poised by mineral exploitation such as abandoned sites, biodiversity damage, use of hazardous use of chemicals with potential health risk to mine workers and neighborhood communities deserved urgent attention. Emphasis should shift from waste disposal to waste minimization through sorting; recycling of regents and water. Safe disposal of unavoidable waste in stable and aesthetically acceptable structure must be enforced through legislation

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