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The Environmental Implication of Illegal Minning Activities in Nigeria, a Case Study of Pandogari and Barkin Ladi/Buruku Surface Mines in Niger/Plateau States.

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Abstract: *Illegal mining is one of the biggest problems with regard to environmental destruction and ecological disruptions. When large numbers of gem seekers and gold diggers converge on a locality and begin their environmentally hostile mining activities in an uncontrollable manner, they cause untold destruction to mother earth, which is often accompanied by pollution of the soil and rivers (with mercury and cyanide in the case of gold diggers). Legal measures have proved totally inappropriate as a means of control, because the form of mining involved requires very little equipment that are highly mobile, hence providing them good chances of evading control. Moreover, supervision becomes nearly impossible when large numbers of such people converge on an area and are willing to use force in defense of their interests. Consequently, damage to the physical and biological environment is accompanied by pronounced social tensions between the various interest groups. This paper presents a critical analysis of illegal mining activities, their environmental effect and remedial measures.*

I. Introduction.

Surface mining is the term used to describe diverse forms of raw-material extraction from near-surface deposits. It involves the complete removal of nonbearing surface strata (overburden) in order to gain access to the resource. Depending on the physical characteristics of the raw material and on the site-specific situation, various surface-mining techniques are applied including dry extraction of loose or solid raw materials. In hard-rock mining, the product must first be "worked" (loosened) then it can be loaded, hauled and processed by mechanical means similar to those employed in loose-rock mining.

Surface mines vary in size according to the nature of the deposit and the employed techniques of extraction. Among terrestrial workings, one encounters mines ranging in size from small one-man operations to huge strip mines measuring several kilometers in diameter. Virtually all surface mining activities have one or several forms of environmental implications that vary in magnitude of severity in the short or long run. Table 1 gives general forms of surface mining and their main environmental impacts whether in the short or long run.

Table 1 - Forms of surface mining and their main environmental impacts (GTZ,1995)

Earths' sphere	dry extraction	wet extraction	nearshore extraction	deep-sea mining
earth's surface	areal devastation; altered morphology: danger of falling rocks at the faces; destruction of cultural assets	areal devastation; altered morphology and river course; formation of large dumps	altered ocean-floor morphology; coastal erosion	
air	noise; percussions from blasting; dust formation due to traffic, blasting, wind; smoke and fumes from self-ignited dumps; blast damp, noxious gases; vibrations	noise due to power generation, extraction, processing and conveying; exhaust gases	noise, exhaust gases	noise, exhaust gases
surface water	altered nutrient levels (potential eutrophication); pollution by contaminated wastewater; pollution by aggravated erosion	denitrification; burdening of recipient with large quantities of muddy wastewater; pollution by contaminated wastewater	turbidity; oxygen consumption; wastewater pollution	turbidity; oxygen consumption; wastewater pollution

groundwater	recession of groundwater; deterioration of groundwater quality	altered groundwater level; altered groundwater quality		
soil	denudation in the extraction area; loss of (agric.) yield, dryout, ground sag, danger of swamping due to local groundwater recovery, soil erosion	denudation in the worked area	altered seafloor; deterioration of seafloor nutrient content	deterioration of seafloor nutrient content
Table 1. continues				
flora	destruction in worked area; partial destruction/alteration in surrounding area due to altered groundwater level	destruction in the worked area		
fauna	expulsion of fauna	expulsion of fauna	destruction of stationary marine life (corals)	destruction of stationary marine life (corals)
humans	land-use conflicts; induced settlement, destruction of recreation areas	land-use conflicts; social conflicts in boom times; induced settlement	impaired fishing (destruction of spawning grounds)	impaired fishing (destruction of spawning grounds)
structures	water damage due to groundwater recovery			
mis-cella-neous	potential modification of microclimate	modification of microclimate; growth of pathogens in still-water areas		

Surface mining operations are inherently bed-bound, their size and location are determined by the given geological conditions of the bedding and associated strata. And since major disruption of the earth's surface is unavoidable in connection with surface mining operations, the question of tolerability under the prevailing conditions must be given due consideration prior to the commencement of any extractive processes. But this is totally absent in the case of illegal mining. Although, nearly all countries of the world have one form of regulations or the other governing mining activities and the treatment of cultivable soil (topsoil). The illegal miners seem to be saying by their actions that such rules and regulations are meant for the educated elites and the registered miners who are most of the time alien to their mining sites and also accountable to the authority that issues the mining leases.

II. Aim and objectives of the study.

This study generally aimed at examining the environmental ills associated with illegal mining activities in Nigeria as a challenge to the environmentalist and the policy makers.

This will be achieved by: Identifying illegal mining sites examine their method of mining activities, highlight the dangers of such illegal mining activities to the local ecological system, and proffer possible solution to such menaces.

Historical background and geographical location of the study areas.

The people of Pandogari is believed to have migrated from Kongoma Village which is also derived from a rock (Duben Kongoma). The major tribes in the town are: Hausa, Dunkwa, Kamberi and other immigrants like the Yorubas, Fulanis, and the Ibos.

Geographically, Pandogari is located on latitude 10^0 7᾽ N and longitude 6^0 5᾽ E. Pandogari is one of the major settlement in Rafi Local Government Areas of Niger State that was carved out from Kusheriki L.G.A. The town is about 135Km north-east of the state capital, Minna.

Barkin Ladi and Buruku are settlement areas within the Jos plateau that rises between 1200m and 1400m above mean sea level. The Plateau lies between 8^0 55᾽ N and 10^0 11᾽ N and 8^0 21᾽ E and 9^0 30᾽ E .This area is generally

described as disaster area by the state government because of the indiscriminate mining activities which over the years devastated the natural landscape.

III. Methodological approach to the study.

Generally, in a study like this, apart from the secondary data collected from published and unpublished books and periodicals, the major source of information is direct personal observation, oral interview and the use of questionnaires which were distributed according to the numbers of neighbourhood clusters in the town as shown in table 2.

A hand-held digital camera was used to capture the various scenes at the mining site. The oral interview was carried out with the aid of an interpreter at the mining site since the local miners hardly hear or speak English particularly in Pandogari site.

Table 2. Neighbourhoods and questionnaire administration in Pandogari

Name of cluster	Questionnaires administered
Kusheriki	154
Ungwan Kwongoma	104
Ungwan Madawaki	140
Gidan Daroa	100
Zara	116
Gidan Kankangi	98
Gidan Damao	101
Ungwan Nananda	104
Gidan Kurao	83
	Total 1000

The equipments and the method of mining at the site.

As earlier mentioned, the illegal miners totally depend on local tools like digger, hoes, axes, cutlasses, buckets, and other local materials for digging. The few modern material used include rock blaster and petrol pumping machine to draw water out of the mining pits.

The drilling of rocks and the evacuation of debris after blasting is purely manual by relay method. Different types of intoxicants are taken orally or injected into the bodies of the young miners who work like machines tirelessly. See figures 1to 4 for the instruments used and site activities.

Fig. 1 Stepwise and relay system of moving debris at the mining site.

Fig. 2 showing the researcher at the mining site taking note on the miners activities.

Fig. 3 Pumping machine draining water out of the mining pit .

Fig. 4 An Abandoned mining pit filled with water which forms a new eco-system.

Legal and illegality in mining operation.

The issue of legal or illegality is a function of the existing political environment and the forces behind any law, decree, bylaw and ordinances in a nation. In Nigeria for instance, the federal government is in charge of all the mineral resources within the country and therefore promulgated the law banning any private individual or group of individual from mining such mineral without being licensed by the appropriate government agencies.

A private miner intending to be licenced is expected to be registered and certified by the Corperate Affairs Commission Abuja and also to apply for a mining lease from the Federal Ministry of Solid Mineral Development, the application is to be accompanied with appropriate survey sketch plans describing the location and the area coverage of the proposed mining site. The agency therefore determines the appropriate royalty to be paid to the government.

Illegal miners generally are not educated and ill-informed about the procedural approach to mining activities within the country. The illegal miners are not ignorant of the existing laws but deliberately ignore such laws with impunity and sometime with assistance from corrupt officers of the federal agencies.

Types of mineral resource available in the two states and those mined at the study sites.

Niger and Plateau States are some of the states in Nigeria that are highly blessed with over 20 types of solid minerals scattered all over the states. For instance, gold associated with quartz veins is located around Minna, Maikunkele, Madaka near Izom and Fasa gurum, while costly gemstones like Ruby, Topaz and sapphire are located in Plateau state, (Adekoya 1995). Mineral exploration within and around Niger State for instance, can be traced back to the year 1911 in the then Niger, Sokoto and Zaria Colonial provinces. Russ W. (1957) reported the occurrences of Kyanite in the then Niger-Zaria province. Also Adeleye (1976) confirmed the occurrences of talc in some part of the state. Table 3 gives the general break down of available solid mineral within the state.

Table 3 Solid mineral deposits in Niger and Plateau States

	Names of Mineral	Industrial uses	Geological formation	Location
1	Columbite	Superconductor, steel alloys	Igneous and Metamorphic	Jos plateau,
2	Galena (Pbs)	Lead and ceramics	Igneous and Metamorphic	Pandogari
3	Gold (Au)	Gemstone, decoration and coating	Igneous, metamorphic and sedimentary	Shiroro, minna, Paikoro
4	Graphite (L)	Facing in foundry mould, paints, lubricants, stove polish, lead etc	Igneous and Metamorphic	Paikoro, Pandogari, Minna
5	Iron ore	Machineries, iron rods, wire, building structures	Igneous, metamorphic and sedimentary	Kontagora, Bida, Rafi
6	Kaolin	Fertilizer, paint, paper, textiles, ceramic, insecticide, pharmaceutical	Igneous, metamorphic and sedimentary	Lavun, Bida, Suleja
7	Kyanite	Brick, spark plug, refractory brick	Igneous and Metamorphic	Shiroro,Rafi
8	Marble/dolomite	Glass, chemical lime, ceramic, pharmaceutical, flux for iron	Metamorphic	Gurara
9	Ruby	jewelry as well as in the making of watches and precision instruments	Igneous and Metamorphic	Jos plateau
10	Sapphire	jewel	Igneous and Metamorphic	Jos plateau, Biu
11	Silica, sand, and quartzite	Ceramic, glass refractory and foundry	Igneous, metamorphic and sedimentary	Gurara, Rijau, Bida
12	Talc	Paint, paper, plastic, cosmetic, textile, pharmaceutical, chemical	Igneous and Metamorphic	Kagara, Kontagora
13	Tourmaline	Gemstone	Igneous and Metamorphic	Pandogari, Munya
14	Tantalite	Metal weaponry (bullet), wrist watch, glass	Igneous, metamorphic and sedimentary	Pandogari, Jos plateau,
15	Tin	used extensively in alloys such as solder, bronze, and pewter and as a protective coating for steel.	Igneous, metamorphic and sedimentary	Jos plateau, biriwai,Kalato
16	Topaz	Gemstone	granites and pegmatite	Jos plateau.
17	Mica	Floor finishing (terrazzo), glass	Igneous and Metamorphic	Pandogari, Bida
18	Barite	Gemstone, weaponry	Igneous and Metamorphic	Pandogari

Source: Preliminary report on solid mineral resources development in Nigeria (1995).

Table 4. Trend of illegal mining activities in Pandogari

Years	Average Area coverage	No. of indigene engaged	No. of none indigene
1992	17. 5km^2	80	25
1998	130 km^2	135	270
2000	200 km^2	330	400
2004	254 km^2	232	475
2006	312 km^2	35	42

Source: Direct field observation and monitoring.

Illegal mining activities in this area are not fully nucleated because exploration of these minerals is being carried out at various parts of the region. In fact, the mining sites are as far as 8km to 10km from the town and without formal motor able road as in the case of Pandogari, Niger state. The amount of spatial distortion as shown in Table 4 progresses as the news spread over the years. But one remarkable point in it is that between the year 1998 and 2000, there was a boom in the trade, hence the influx of people to that locality. The trade boom was so high to the extent that the then state governor has to visit the site with the intension to arrest the suspects. The local people that are exposed to the trade actually started the operation before the none-indigene gem-seekers flooded the area.

Open-cast mining of Cassiterite and columbite in Barkin-Ladi and Buruku also render the landscape of this area denuded. It is estimated that some 372km^2 of the total 8600 km^2 of the Plateau had been damaged by all sorts of mining activities of which about 40% are by illegal miners. In fact structural developmental activities in most parts of Jos Plateau is made difficult and costly due the undulating nature of the terrain.

The physical Environmental effects of the mining activities.

Surface mining operations generally alter the morphological makeup of the mining site as a result of digging, quarrying and dumping of debris heaps. Once an abandoned mining site has been left unreclaimed, such area becomes a badland resembling erosional features like canyon, mesa-buties and residual (submorphic) hollows, And their sizes depends on the dept of the targeted mineral and how much of those material has been extracted from the site. Morphological changes can be particularly pronounced in hard rock mines, which tend to have very steep slopes and for which little material is left for refilling (e.g., in stone quarries). At the mining site in Pandogari, the overburden dumps left behind at the time of opening the mine, and the abandoned polje-like wells that often causes ground subsidence by dewatering.

The mining activities also interfere with the surface water courses. Series of major river tributaries and brooks were diverted from the mining wells which also affected the river regime. Apart from this, the washing of the mined minerals and the rain storm find their ways into the neighbouring streams thereby causing river turbidity and alkalinity. For instance according to Akinyede et al (2003), quoting Walter Lichem (2003), about 5000 times more people die each year from water-related diseases. The fact remains that; illegal miners are not mindful of any environmental implication of their activities and therefore no plan for mitigation of any form. The alteration of the soil profile and rock-bedding plain at the mining site also interfere with the groundwater regime. There is a resultant loss of groundwater quality due to the infiltration of contaminated wastewater and in washout and leaching of dumps, heaps and the mine itself.

Interference with the biological environment.

The extraction activity imposes noise pollutions on their surrounding areas particularly from the drilling and blasting of mineral bearing bedrocks. In addition to the sound of the explosion, the attendant vibrations and reverberations amount to an additional dynamic burden on the environment that does not only annoys the neighbouring settlements, but are potential sources of structural damage. Allied to this, is the fauna life. The noise and vibration effect of the mining activities on the animals and birds forces them to escape from their natural habitat which may also have negative impact on their bio-physical life cycle.

On the local flora life (vegetal cover), apart from the clearance of sizable area for the mining activities, the incidence of micro-fine dust (aerosol) generated from rock explosions settles on the plant leaves thereby reducing the process of photosynthesis which on the long run can lead to stunted growth of vegetal life.

Aquatic ecosystems.

Aquatic ecosystems can be disrupted by qualitative and quantitative changes in surface water conditions, while wetlands can be altered by groundwater level distortions. Fragile ecosystems in extreme locations are particularly susceptible to permanent damage or destruction.

Finally, on the economic aspect, although high proportions of idle youths find solace at such mining site, the negative effect on the food security is enormous. Fertile expanses of land that are devastated and rendered uncultivable for long period of years deny the farmers' access to such scarce land, hence a general

decrease in food production. Even after the mine has been abandoned and re-cultivated, the residual changes in soil physics and chemistry, available water resources, etc. can lead to the appearance of different plant and animal associations constituting an irreversible alteration stemming from the mining disruption.

IV. Conclusion

Conclusively, the issue of illegal mining in the country is detrimental to human environment as earlier discussed especially in the rural areas where those minerals are located. Also the government at all level seems to pay lip-service to the doctrine of sustainable environmental development as advocated for in Agenda 21 of the UN. The local communities should therefore be educated on the need to keep watch over illegal miners' activities within their area for their well-being and posterity sake.

V. The way forward.

The federal through the state government should work together with local village heads in whose jurisdiction the mineral of interest is located (in spit of the controversial Land Use Decree of 1978) to protect the resources and the environment at large.

The government through the law enforcement agents and even the custom officers control fully the marketing and exportation of solid mineral in the country since most of those mineral are not locally utilized.
The local people should be sensitized and educated through open crusades and mass media to be a watch-dog over their land on which they depend for their agricultural produce.

The relevant government agencies through the law enforcement agencies should be able to monitor and ensure payment of royalty. They should also ensure that as soon as the mining activities are completed, appropriate rehabilitation measures are carried out by the miners. To rehabilitate means to immediately transform the areas concerned into a natural landscape as possible. Dumps, open-pit perimeters, outside dumps and erstwhile extraction areas require immediate green-belting or planting with indigenous vegetation in order to limit or prevent erosion. Special erosion control methods such as drainage and consolidation must be employed in vulnerable areas.

The ultimate aim of reclamation must be to fully re-cultivate the worked out areas to enable appropriate and corresponding use, or to re-nature them for another purpose. To reclaim the land, it must be graded, compacted and covered with soil and humus to allow immediate re-grassing and subsequent soil management.

A pre-commencement status quo study with thorough investigation of all matters relevant to the physical, biological and social environment provides a crucial basis for evaluating the environmental consequences of surface mines and planning re-cultivation measures.

The mining operators should be made to pay some amount of caution fee equivalent to the cost of restoring the damaged environment close to its original state. But if the operator can satisfactorily rectify the damage satisfactorily, then the amount so charged will be refund back.

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