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The Nexus between Unsustainable Mining, Livelihood and Environmental Degradation: A Case of Tin and Columbite Mining on Jos Plateau Nigeria

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ABSTRACT

Tin and columbite have been extensively mined on the Jos plateau since the time of the colonial era. Tin and columbite mining were characterized by many unsustainable practices that adversely impacts on the environment. The study examines the nexus between the unsustainable practices associated with the mining activities, the livelihood opportunities it provided to the residents and the environmental degradation that results from the mining activities in the study area. The study is based on field visit to some of the active and abandoned mine sites and reclaimed mine sites. During the fieldwork, observation and measurement were made and recorded. Interviews of some artisanal miners, mine supervisors and staff of mineral processing company were made and the data collected analyzed using content analysis method. The findings of the study reveals that tin and columbite mining activities degrade the land thereby reducing land needed for farming and building of residential houses. Despite the risk associated with it, tin mining provide a lucrative source of livelihood to many natives in the area. The laborers were paid between ₦50,000 to ₦100,000 daily according to some of the people interviewed. Although this depends on the amount of tin extracted, the earning of ₦50,000 daily is more than the national minimum wage of N33,000 per month. Despite the risk associated with mine openings, effort to reclaim the abandoned mine has been very slow. Based on the findings, the study recommends the need for surface mining control and reclamation Act, abandoned mine reclamation fund and the need to tie ecological fund to specific projects that promote ecological restoration, conservation and preservation.

KEYWORDS

Artisanal mining, Columbite, Environmental degradation, Sustainable livelihood and Unsustainable mining.

Introduction

Mining is one of the economic activities that presents opportunities for the attainment of the Sustainable Development Goals (SDGs) in developing countries like Nigeria. Previous studies have shown that solid mineral exploitation constitutes more than 1% of Nigeria's GDP as most of the mining activities are still mainly carried out by the informal sector with over 95% of mining activities carried out by artisanal and small scale miners, out of which 95% are illegal (Uzoka, 2001). Although there have been so many studies on mining activities and their environmental impacts over the years, it is only recently that the issues of mine closure and rehabilitation have been included in mining discourse as contained in the Minerals and Mining Act 2007. Most of the mines or affected mining pits were abandoned or left in an inadequate reclamation status.Today, the Federal Government of Nigeria is faced with the challenges of reclaiming the abandoned mine lands and reducing their hazards at a time when the country is facing serious financial constraints, budget cut, land issues (crisis/conflict) and lack of comprehensive inventory of these abandoned mine pits (Ahmed&Oruonye, 2018).

Tin and columbite have been extensively mined on the Jos Plateau since the time of the colonial era. Tin and columbite mining were a major source of revenue to the colonial government. Tin mining then was done by mechanized method, which greatly impacted on the environment with proliferation of abandoned mine pits and ponds that litter conspicuously the length and breadth of Jos Plateau. The mining then was done without any regulation or consideration to the environment in terms of decommissioning of mines or reclamation. Tin mining witnessed decline after the Second World War and the discovery of crude oil in Nigeria and was reported to attain an all-time low in 1985. However, after many decades of abandonment, there is a resurgence recently of tin and columbite mining on the Jos Plateau. This resurgence is dominated by artisanal small-scale miners. Their activities are informal and illegal and mostly on areas that have been mined before. The activities of the artisanal miners are characterized by many unsustainable practices that adversely impact on the environment. It is therefore important to examine some of the mining practices that make the activity environmentally unsustainable and unfriendly. It is against this background that the study examines the nexus between the unsustainable practices associated with the mining activities, the livelihood opportunities it provides to the residents and the environmental degradation that results from the mining activities in the study area.

History of Tin and Columbite Mining on Jos Plateau

Mining of mineral resources on the Jos Plateau is as old as 2000 years according to a report by the Federal Department of Antiquities in 1979 (Ashawa Consult, 2007). During the earlier period, tin was traded locally. It was mined and taken to Liruerin Kano and Liruerin Delma for smelting and local use. The trade grew and extended to the Mediterranean basin across the Sahara and subsequently the southern markets such as Lagos, Benin and Calabar. Later development resulted in the introduction of camels into Africa as mode of transportation in the 12th century which facilitated the penetration of the Gulf of Guinea by the Europeans in the 18th and 19th centuries. The British merchants discovered bundles of tin metal sticks being traded locally at Ibi along the River Benue and traced it to local smelters in Liruerin Delma (Ashawa Consult, 2007). Eventually, the British merchants discovered that the tin ore was obtained from the Delimi River on the Jos Plateau in 1894.

Thus, large scale tin mining activity started with the discovery of large tin deposit at Tilden Fulani and Delimi River in 1902 and 1903, respectively using manual labour. Extracted tin ore was transported on foot from Jos to Loko on the Benue River for onward ferrying to the southern part of

the country. Locals were forced to trek for a distance of over 320km to Loko in Nasarawa State with tin in head pans on their head (Mangvwat&Kwaja, 2015) because there was no other way they could get the large amount of tin mined to the ship barge at Loko. The tin was then ferried on the River Loko, a tributary of the River Benue down to Lokoja and eventually to the south where it was shipped to Europe. The increase in demand for tin ore led to the construction of railway lines to Bukuru in 1911 and Jos in 1915 and subsequently road construction complimented the railway.

The colonial British government granted exclusive mining rights over Jos Plateau to the Royal Niger Company. The success of the company led to influx of some 139 companies most of which were British owned foreign companies (Ashawa Consult, 2007). It was reported that this period was responsible for most of the land degradation caused by mining in the Jos Plateau area. These big foreign companies led the way for the large scale environmental degradation seen on the Jos Plateau and were assisted by native miners who dug shallow pits in and around their workable reserves (Ashawa Consult, 2007).

At the beginning, columbite was regarded as unwanted byproduct of tin until the 1930s when its value was discovered as important material required for making heat and corrosion resistant alloys for manufacturing jet engines. This development led to increase production of columbite from three (3) tonnes to over 2,000 tonnes in 1944, which slightly dropped after the World War II (Ashawa Consult, 2007). The demand for tin was driven by the need to prosecute the World War II, railway construction and production of guns and ammunition. After the World War II, there was decline in the demand for tin in the global market. Later there was the Nigerian indigenization policy which led to the taking over of most companies by Nigerian government and indigenous firms. The discovery of crude oil in 1958 also diverted the attention of the Nigerian government from the solid mineral and agricultural sectors to the oil production sector. Tin tapered through to an all-time low production in 1985.

Description of study area

Plateau state is situated between Lat 8°30' and 10°30' N and Long 7°30' and 8°37'E in Nigeria's central belt zone. Its borders are shared by the states of Bauchi in the north, Taraba in the east, Nasarawa in the southwest, and Kaduna in the west. The land mass of the State is about 26,899 km^2(Akintunde et al., 2022). There are seventeen (17) local government areas (LGAs) in Plateau State. Jos is the capital city of the State.

With the exception of its northern portion, the town of Jos is nearly entirely encircled by hills: to the east are the Dogon Dutse and Shere Hills, rising to elevations of over 1,300 and 1,800 meters above sea level, respectively; to the west are the Jenta Hills, rising to elevations of over 1,280 meters above sea level; to the south are numerous small and large inselbergs, rock outcrop. The topography in the north is exacerbated by numerous abandoned mining paddocks, though some of these have been reclaimed. Jos is situated within the basin of the Delimi River, a tributary of the Shari River system, which flows to the north-east and empties into Lake Chad.
The developed region of Jos lies between the Delimi and its tributaries, the most significant of which are the Niger, Curly, and Canteen Creeks. These streams have water in them from April to October during the rainy season, but they dry up in the middle of November to March during the dry season due to the seasonality of flow brought on by the rainfall regime. But these days, the majority of their channels have been enlarged by mining and other operations, like sand quarrying for construction, which has left large pools of water throughout the dry season (Charles &Osuala, 2015). Jos town has lower temperatures and occasionally more rainfall than the nearby towns due to its altitude.

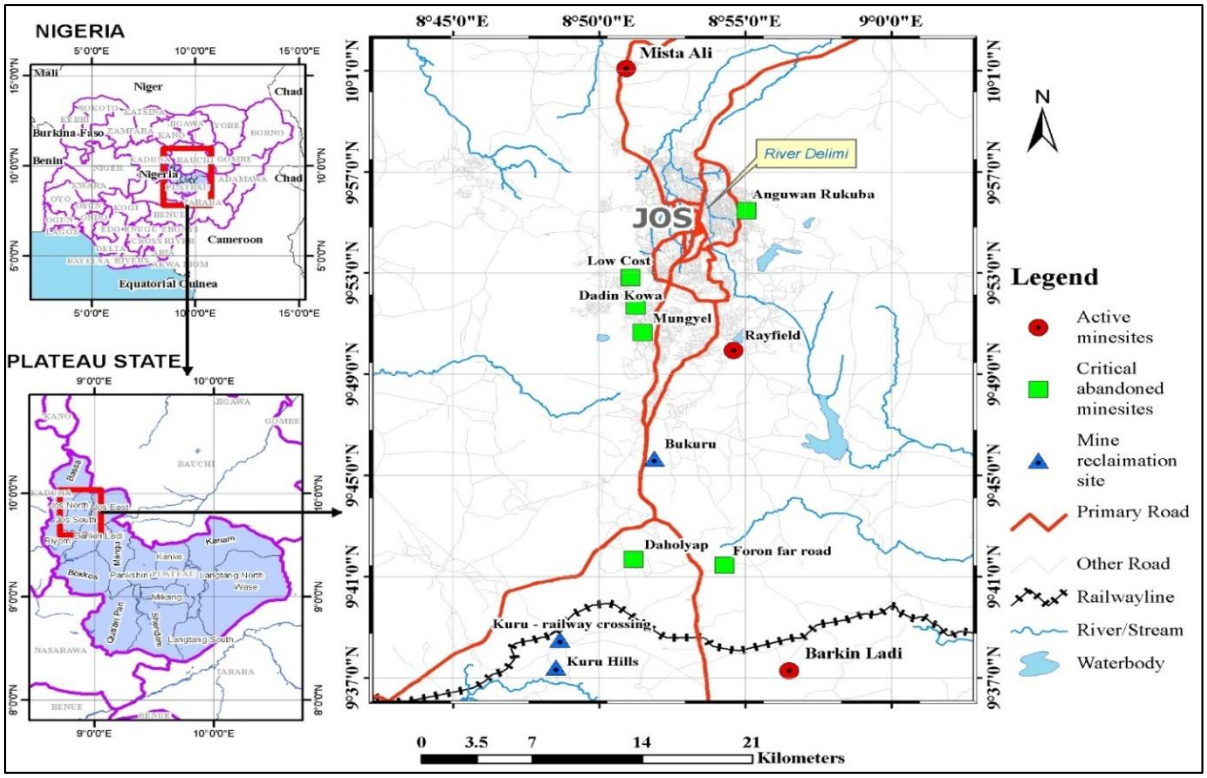

Fig. 1. Jos, Plateau State, Nigeria (The Study area)

Methodology

Primary and secondary data were used in this study. The secondary data involved desk review of existing online resources on tin mining on the Jos Plateau. The primary data was generated through fieldwork undertaken by postgraduate students of Taraba State University, Jalingo on the 8th and 9th February, 2024. Thus, this study is based on visit to some of the active and abandoned mine sites and reclaimed mine sites in Jos and its environs during the fieldwork. Observation and measurements were made and recorded. Some of the artisanal miners, mine supervisors and staff of a mineral processing company in the area were interviewed. Content analysis method was used to analyse the data collected.

Result of the Findings

Artisanal Tin Mining on the Jos Plateau

Tin and columbite mining on the Jos Plateau is characterized by mix method of illegal artisanal small scale mining and semi mechanized formal mining company. The artisanal small scale miners use simple crude implements of axe and diggers to dig tunnels in the ground following the tin ore vein. The soil materials containing the tin ore are pulled out in a bucket-like container (Plates. 1a & b). The tin ore-bearing soil materials are deposited on the surface and washed with large quantity of water until the tin particles are isolated (Plates 2a & b). Some of the tunnels can be up to 14 metres deep or more.

The semi mechanized tin mining company sometimes exist side by side with the artisanal illegal small scale miners as was the case at the Rayfield mine site where Niguas Rayfield Resort Columbite mine co-exist, side-by-side, with artisanal tin miners. Although it is said to be semi mechanized, the

company uses heavy duty equipment such as excavators and tippers to excavate the ground and bring out the soil (ore) materials containing tin and columbite (Plates 3a &b).

The artisanal small scale miners are nomadic in their operation as they move from one site to another in desperate search for new tin ore location. Their activities are further aggravated by some of the small and medium licensed mining companies that resort to buying the extracted tin ore from the illegal artisanal small scale miners to save costs instead of going into direct mining operation themselves.

Plates 1. a & b. Illegal artisanal small scale tin mining at Rayfield, Jos Plateau, 8/2/2024

Plates 2. a &b Heavy duty equipment used in Semi-mechanized tin mining company, 8/2/2024

Plate 3. a & b. Freshly extracted tin ore, 8/2/2024

Unsustainable mining and environmental degradation

Tin and columbite mining activities degrade the land thereby reducing land needed for farming and building of residential houses. Despite the perceived insecurity on Jos Plateau, the town has witnessed large influx of migrants in the last decades resulting in high demand for residential settlement. Hitherto unoccupied hillslopes are not only occupied now by residential buildings but even the hilltops have been occupied by residential buildings especially along Bauchi road and Zaria road in Jos metropolis.

i. **Environmental degradation:** The Land Resource Development Centre in 1976 estimated that about 316km^2 of the land area of Jos have been degraded while Alexander (1985) estimated the degraded area to be about 325km^{2}of land area representing 4% of the Jos Plateau surface. Cooper (2012) translated this to about 225 km of land area taken out by tin mining activities. When one considered the fact that Jos is a hilly area, this quantity of land became significant. Mining activity mostly took place on the native farmlands and the people were not paid for the land but compensated for their crops. This further reduced the available land for farming on the Jos Plateau.

ii. **Increased Migration:** By 1945, there was large scale migration of people to Jos for mining. Jos has a population of 80,000 African workers by 1943 (Cooper, 2012). Jos was probably the most cosmopolitan city in Nigeria with almost every section of Nigeria well represented and large number of migrant workers from Sierra Leone, Liberia, and other West African countries. Most of them focused on mining activity.

iii. **Shortage of Food Supply**: The natives were forcefully conscripted into the mining activity as labourers. So, there was no enough food grown on the Jos Plateau then to feed the increasing population. This situation caused riot in the labour camps of the mining companies. This resulted into the introduction of Irish potato from Ireland in the United Kingdom to the region as a stop-gap arrangement to address the problem of hunger. Also, the top soils were disposed indiscriminately. The farmers in some cases had to level heaps of overburden at the mine site to be able to plant their crops on the land that is not fertile resulting into poor yield.

iv. Mining activities have greatly affected the vegetation of Jos Plateau and its environs. Typically because of its terrain, the vegetation cover was montane, a part of the Guinea Savanna grassland, with flourishing tree covers and large tall grassland as a result of relatively large amount of rainfall due to its relief. To gain access to the tin ore however, the land area was stripped of its tree cover in many places. Other factors such as human exploitation have also contributed to the loss of the original woodland vegetation (Buckley, 1986). Only isolated hilltops, which remained untouched by mining activities currently bear any resemblance to the original montane vegetation cover.

Abandoned mine sites on the Jos plateau

Abandoned mines are regarded as mines that the owners cannot be found or for which the owner is financially unable or unwilling to carry out clean-up after mining activities. Generally, the causes of abandonment of mine sites in Nigeria vary across the country and range from economic factors, poor regulation and enforcement, and activities of small scale miners.

The uncoordinated and uncontrolled working of mine sites by illegal artisanal small scale miners contribute greatly to the number of abandoned mine sites. Some of them practice seasonal mining

while others are constantly on the move from one site to another in search of suitable sites to mine. Their stay at each location is usually very brief, in some cases lasting only a few days.

Poor regulation /policies: no policy or regulation was in place to provide government with financial security in the event of a mining company going bankrupt and being unable to cover the costs of the rehabilitation of its mine sites. For this reason, government policies have not been effective. Government enforcement, usually, due to lack of capacity, also contributed to the increased number of the abandoned mines. In a study on inventorization of abandoned mines and quarries in Nigeria, Ashawa Consult (2007) reported 732 sites, the highest in the country. After the nationwide inventorization of 2006, new mine sites have been worked, reworked and abandoned. There have been unconfirmed claims by some sources that the Department of Mines and Environmental Compliance in the Federal Ministry of Mines and Steel identified over 1,000 mine openings on the Jos Plateau between 2009 to 2010. One thing that is certain is that the number of mine openings on Jos Plateau is a source of concern to both the government and residents of the town (plates 4a & b).

Mine Processing

The breathing method was used to determine the grade of the tin at Dach Mine separation company located in Rayfield, Jos. The tin ore extracted from the mines is sprayed with jets of large amount of water to wash away most of the unwanted soil material. The tin, combined with the remaining soil material is dried in an open space and recollected into bags (Plate 6). At the Dach Mine and similar separation companies, the dried soil is separated into tin and its associated minerals of columbite and iron ore (Plate 5). The quality and market value of tin and columbite are then determined using the breathing method (Plate 7).

Plate 4. a & b. Mine openings at Rayfield, Jos Platea

Plate 5. Tin & Columbite separation at Dach Mine companies **Plate 6.** Drying of tin & columbite ore

Plate 7. Determining tin value by breathing method

Mining and Livelihoods on Jos Plateau

There are hundreds of active artisanal tin mining sites on the Jos Plateau. Some of the mining sites are located in Mista Ali, BarkinLadi, Rayfield, Kuru and Buruku areas, among others. Over 600 workers were seen at the Dura Du mine sites in Rayfield Jos (Plate 1 a & b) during the fieldwork. The laborers were paid between ₦50,000 to ₦100,000 daily according to some of the people interviewed. This, however depends on the amount of tin extracted. To put this earning in context, N50,000 is more than the national minimum wage of N33,000 per month. The lure to earn such an amount in one day is overwhelming for many people in spite of the risks involved. Lease owners earn in multiples of hundreds if the site is productive. In some cases, however, the sites may yield little or almost nothing. But for many people, artisanal mining is the main source of livelihood and present economic opportunities that are unmatched by other enterprises at the miners' social and economic levels.Interviews with the miners indicated that the walls of the tunnels often collapse and many miners have been lost in such manner. Nevertheless, this is a risk many miners are willing to take daily.

Reclamation of Abandoned Mine Sites

Reclamation of abandoned mine land is the process of restoring the ecological integrity of areas that have been mined. Mine reclamation is the process of modifying land that has been mined to ecologically functional or economically usable state. In this process, derelict or highly degraded lands are returned to productivity, and some measure of biotic function and productivity is restored

(Sheoran& Singh, 2009). Ecological restoration and mine reclamation have become important parts of the sustainable development strategy of many countries. Good planning and environmental management minimize the impacts of mining on the environment and help preserve its diversity.

Before 1946, there was no formal and specific mining regulation on reclamation of mine sites. Consequently, leaseholders and mining companies did not have any incentives to restore and reclaim the mined areas (Alexander, 1985). This was the peak of the active mining on the Jos Plateau. Top soils and overburden from the tin and columbite mining were usually disposed indiscriminately without consideration for the environment. According to Alexander (1985), after 1946 there was insertion of the clause on reclamation in the Nigerian Mineral Act of 1946, specifically in the Laws of the Federation of Nigeria, Ordinance Chapters, Chapter 121 Minerals, Mining Part IIIB, Mining Leases, Paragraph 34. The law empowered the Governor-General, who as the granter "may require a reasonable restoration of any area used for mining operations…" This Act now known asMinerals Act (Chapter (Cap.) 121 of the Laws of Nigeria and Allied Regulation (now contained in Cap. 266 LFN 1990) came into effect in 1946 as a remedial policy package on the mine fields. From 1946, mining companies were made to take responsibility for the primary restoration of mined-out land. The first reclamation exercise that came out of this development was that of the planting of eucalyptus trees directly onto the overburden heap opposite Ladi Club in BarkinLadi town (Ashawa Consult, 2007). This was succeeded by the planting of trees at the present site of the Police Staff College, Dorowa, Gindin-Dutse and at Kuru (Plate 8). It was reported that the success of the mine reclamation with the eucalyptus plants led to the establishment of the Mines Land Reclamation Unit (MLRU) in 1948 by the regional government of Northern Nigeria, which was collecting about 80% of the royalties from tin mining and fees on mining leases (Ashawa Consult, 2007). Unfortunately, the early successes recorded in reclamation did not last long. The overwhelming verdict is that the reclamation of the mine areas in Jos was a failure. Alexander (1985) identified three important factors for the failure. First, there was a lack of political will or unwillingness on the part of government to enforce the reclamation clause, which in any case was vague and apparently deliberately imprecise and confusing, as to what amounted to "reasonable restoration." Secondly, the mining company insisted that areas no longer mined did not mean they would not be reworked. Reclaiming them would forgo their rights to rework them. They therefore refused to surrender their leases, which in many instances were yet unexpired. The companies had 99-year leases, which technically meant they could claim to be still in or open to continuing operation. Thirdly, the value and price of tin in the global market had fallen since the end of the war, which meant that mining companies were no longer making fortunes from mining activities. An enforcement of the law could have resulted into bankruptcy for many of the companies. In essence the decision to abandon and not reclaim the mined lands by mining companies was an economic decision. To do otherwise would have been economically suicidal.

Abandoned mines pose risk to people and the environment. They can contaminate ground water, emit toxic waste and cause injury when unsteady infrastructure collapse. Abandoned mines also pose health and safety hazards, degrade the environment and prevent the productive use of the land. Since the cessation of active, mechanized tin mining in Jos and environs, concerns over slow violence of radioactive materials from the mined fields have been raised. Studies have shown that the amount of radioactivity recorded in abandoned tin mines in BarkinLadi and the suburbs of Jos are potentially harmful as their cancer risk exposure rates are greater than globally acceptable limits (Aliyu, Mousseau, Ramli, &Bununu, 2015; Masok, Ike-Ogbonna, Dawam, Jwanbot, &Yenle, 2015). Thus mine reclamation is aimed at making abandoned mine sites safer for people and the environment.

Plate 8. Stone pitching reclamation at Kuru Kuru

Plate 9. Eucalyptus plantation at reclamation site,

Plate 10. Wall retention constructed at Bukuru, Jos

There are many different types of mine reclamation, which depends on the intended uses of the land such as water supply, housing, farming, wall retention purposes or other construction work. Mine reclamation can be done using many different types of materials such as overburden removed during mining, planting of trees as was done at Kuru (Plate 9) and stone pitching (plate 8) which can sometimes be combined with construction of wall retention measures (Plate 10). Reclamation can also be done by construction of check dam at the head of an erosion site in a form of terracing to stem the velocity of the running water, and then the water can be released gradually and controllably. The check dam can be used for irrigation, fishing or other purposes as the case may be.

Over the years, government has made effort to reclaim some of the mine sites but this effort is very slow and negligible. This is because there is no direct policy on reclamation of these mine openings. What is available at the moment is the initiative of the department of mines and environmental compliance following flood of complaints by local communities of dangers posed by the mine openings in their communities during the inventorization process. For example, it cost the Ministry of Mines and Steel about two hundred and sixteen million naira (₦216,000,000) to construct the Bukuru retention wall between 2009 to 2010 (plate 11). There is hardly official report of the extent of the problems of the abandoned mine sites to the government. Even when the last nationwide inventorization of abandoned mines in the country was done, the final report hardly attracted government attention to provoke policy initiative. This attitude is reminiscent of the laissez-faire attitude of the colonial government to enforcement of land reclamation regulations. It is hypothesized that the employment provided by illegal artisanal tin mining activities and possible collusion and corruption by government officials may account for the near-absence of government regulations in the illegal tin mining industry on the Jos Plateau.

Conclusion

This study has examined the nexus between unsustainable mining activities, livelihood and environmental degradation using the case of tin and columbite mining on Jos Plateau Nigeria. The study was carried out based on field observation and interview of the artisanal miners and officials of the mining company visited. The findings of the study reveal that mining of tin and columbite on the Jos Plateau has had a devastating effect on the environment resulting in large number of mine openings, reduction of land for farming and building of houses, among others. Current economic realities in the country have reignited interest in tin mining. Artisanal small scale miners in search of economic fortunes, using manual and traditional methods have reopened new areas around old abandoned tin mines. Once their fortunes are found, or not, the contingent of illegal miners move to other sites to continue prospecting, abandoning the site, unrestored and posing danger to nearby communities. This has added to the original area of mined fields. This unsustainable mining practice has caused devastating impacts on the environment and safety of the population but has endured because of the lackadaisical attitudes of the government and its agents to enforce the rules and regulations governing mining of mineral resources in the state.

Recommendations

Based on the findings of the study, the following recommendations are made:

i. There is an urgent need for surface mining control and reclamation Act that will make provisions for set standards for both prospective and active tin and columbite mining companies to compulsorily reclaim past mining areas while they mine others. The mine reclamation regulation will define the mine closure process that efficiently and effectively returns mines to either their former state or makes them habitable for some other purposes.

ii. There is need for abandoned mine reclamation fund. The fund will generate money from tax on tin and columbite mining from individuals and companies. This presupposes that the government emplaces a framework to register, monitor and tax individuals and companies involved in residual tin and columbite mining on the Jos Plateau. It is instructive that the illegal artisanal tin miners are actually organized into groups or collectives and therefore can be easily accounted for.

iii. The Ecological fund provided by the Federal Government to states in need should be tied down to specific projects that promote ecological restoration, conservation and preservation.

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