

## Assessing the Impact of Mining Activities in Kwakwalagi Mining Site of Riruwai, Kano State

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### Abstract

*Mining activities continue to be sited in mineral prone communities in Riruwai. Little is known of the environmental consequences of such activities in a relatively new and heavy mining area of Kwakwalagi in Riruwai town. This study used both qualitative and quantitative data analysis Riruwai town and has a total population of 11,411 people being the largest town in the local government after Doguwa town. A field survey was conducted to collect data. Random sampling techniques was adopted for the selection of the respondents for the interviews and published records, documents such as project documents, village profile, maps, photos, internet sources was used . A further checklist was use to analyze the environmental impacts of mining activities, and however a leopard matrix was adopted to analyze the environmental impacts of mining activities in the study, the area considered as very highly contaminated site. The study shows that a total of 15.55 hectares area is impacted by the mining activities using impact valuation matrix..Destruction of forest and farm lands alongside water pollution, loss of biodiversity, soil erosion, air pollution and alteration of soil profiles, was reported as the main environmental impacts experienced by the people in these studied. Government, both national and local, community leaders, and the miners need to play their respective roles of enforcing regulation, promoting public education and practicing environmentally sound mining so as to reduce the rising concerns of environmental degradation from mining.*

**Keywords:** Assessment, Consequences, Environment, Impact, Mining activities

### INTRODUCTION

Over the years, mining evolved all over the world to include various minerals such as the mining of Malachite at Maadi by ancient Egyptians, Gold and Iron at Wales by the Romans and Turquoise in pre-Columbian America (Shau, 2001). Mining in Nigeria started as far back as the eighteenth century. It is known that Over 500 occurrences and deposits of over different minerals are known so far to exist within the country with the exploration of some of them being on a small scale (Adegbulugbe, 2007). One of the major cases of mineral exploration that boomed within the nation has been that of tin in Jos. Tin is said to be one of the oldest mineral resources known to man as its strategic importance was recognized as far back as some 300 years ago when its hardening effects on copper was discovered (Adegbulugbe, 2007). Since then, tin ore has been mined in several parts of Nigeria including Zaria, Kano, Bauchi, Ilesha and Plateau provinces, with over 80% of the production coming from the Jos Plateau (Ajaegbu, Adepetu, Ajakpo, Ihemegbulem,

Jumbo, Olaniyan, Okechukwu and Schoeneich, 1992).

The production of tin in Riruwai during the colonial era started with about less than 1 metric tons in 1914 and then began to increase until a peak production of more than 600 metric tons was reached in 1943 (when Nigeria became the 6th world producer). In 1970, however, tin mining declined rapidly due to the behavior of the market of tin and a diversion of interest in Nigeria towards oil production and export (Patterson, 1986). With tin mining activities going on in various sites of Riruwai town at formal and informal levels, the environmental effects within the natural and built environment comes readily to mind.

Mining activities contributes to the economic and social wellbeing of the host communities through illegal mining but also results in land degradation, deforestation, erosion and pollution. In Riruwai settlement of Kano state, residents of the areas are involved in mining activities without considerations to the physical environment. The mining activities in Riruwai, have

been observed to lead to negative impact for future development of the town and the dwellers. The extracting and excavation of minerals like; tin and columbine, tamalines, precious stones and tantalums. This minerals or resources have contributed to the both negative and positive effect on the environment. The resultant effect of such practices has been major drivers for water pollution, gully erosion, destruction of farmlands and death trap and loss of biomass. Mining activities results to difficulties to access clean potable water by the residents. Surrounding rivers are polluted and those taken by the public are always dirty and contaminated. All the roads have developed heavy potholes owing to the heavy-duty trucks that ply the roads. Most of the pits dug by miners were not covered serving as a danger to the residents, especially during rainy seasons when the pits are covered by water. This study assesses the impact of mining activities in Kwakwalagi mining site of Riruwai with a view of finding appropriate planning recommendations for mitigation.

### **Concept, Method and Process of Mining**

#### **History of Mining**

From prehistoric times to the present, mining has played an important part in human existence (Madigan, 1981). The history of mining is fascinating. It parallels the history of civilization, with many important cultural eras associated with and identified by various minerals or their derivatives: the Stone Age (prior to 4000 B.C), Africa and India, Columbus's discovery of the New World, and the modern gold rushes that led to the settlement of California, Alaska, South Africa, Australia, and the Canadian Klondike were achieved with minerals providing a major incentive (Elaine Scott 2012). Other interesting aspects of mining and metallurgical history can be found by referring to the historical record provided by

American Geological Institute, 1997). Mining on the whole is the extraction of valuable mineral resources or other geologic materials from the earth, usually from an ore body, vein or seam (AbuhMomo et al., 2013). It can also be said to be an act or process of extracting minerals of economic importance from their natural environment and transporting them to points of processing and use.

According to Altun, Yilmaz and Yildirim, (2010), mining is the extraction of minerals or other geological materials from the earth from its ore body. Ores recovered by mining include metals, coal, oil shale, gemstones, limestone, rock salt, potash, gravel and clay. Mining is required to obtain any material that cannot be grown through agricultural processes, or created artificially in a laboratory or factory. Mining exist in many countries.

### **MATERIAL AND METHOD**

#### **Study Area**

Riruwai an ancient town was said to have been founded by a hunter named "Bello Bazata" who discovered a spring of water flowing out of the cave. He informed his colleagues about his discovery and they decided to settle there. The name "Riruwai" is believed to be derived from "ba mu ruwa mu sha" meaning "give us water to drink" which was transformed to "ba mu Riruwai mu sha". (According to Sarkin Riruwai, i.e., District Head of Doguwa).

Riruwai as Doguwa local government headquarters is located at the extreme southern tip of Kano state, and it is also called foot slope of Jos Plateau. It lies between latitude 10° 43' 97''N – 10° 45' 01''N and longitude 8° 43' 3''E - 8° 45' 86''E. In the north and east Riruwai borders with Zainabi ward, Doguwa ward in the north and east, Ragada ward in the west and Dariyeshere in the south.

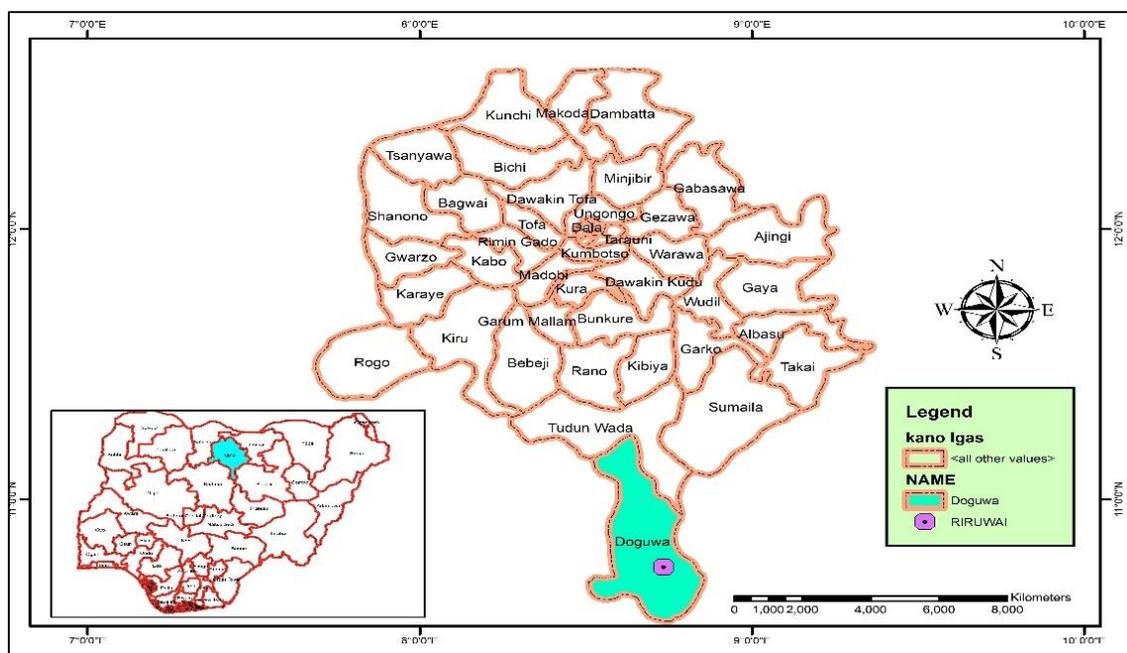


Figure 1 Riruwai, Doguwa LGA, Kano State (Study Area)

### Methodology

In methodology for assessing impacts, the project and its environmental context were analyzed in several stages: The study employed both qualitative and quantitative techniques. Where, data are collect through Checklists, Preparation of Impact Matrices, Valuation of the Impacts, Determination of Significant Impacts, Data sources included both primary and secondary data. The sampling frame for the study takes into cognizance of only one mining site, in Riruwai settlement, which is “Kwakwalagi.”

The interviews were purposively selected based on the community leadership, positions and the members of the focused group discussions as public participation. Those that were selected include; local government’s Head of the department (HOD) community, the village Heads, Mai Unguwa and business men involved in mining activities and community-based organizations

### Methods and Techniques of Environmental Impact Assessment

According to EndreDomokos (2009)’ towards (getting ready) for the next millennium, the environment and development inconsistently connected tend to become a key issue or rather the key issue. On one hand huge technological and consumption systems have been established, So

many studies were conducted on the process of environmental impact assessment, others focus on the method and techniques of environmental impact assessment. Therefore this study is focus on a review of methods and techniques of assessing the environmental impacts of mining activities.

### RESULTS AND DISCUSSION

#### Data Analysis and Presentation

The identification, analysis and valuation of environmental impacts take into account activities information and scopes. Such assessments are carried out by identifying the mining activities or actions that are likely to cause environmental impacts and the environmental components and elements in each medium that may be impacted by those actions or activities. The potential positive effects that the mining may have on its environment are also considered. The valuation of impacts makes it possible to determine their magnitude and significance, which enables the preparation of an environmental management plan oriented to eliminating, mitigating or compensating for negative effects and leveraging the positive effects.

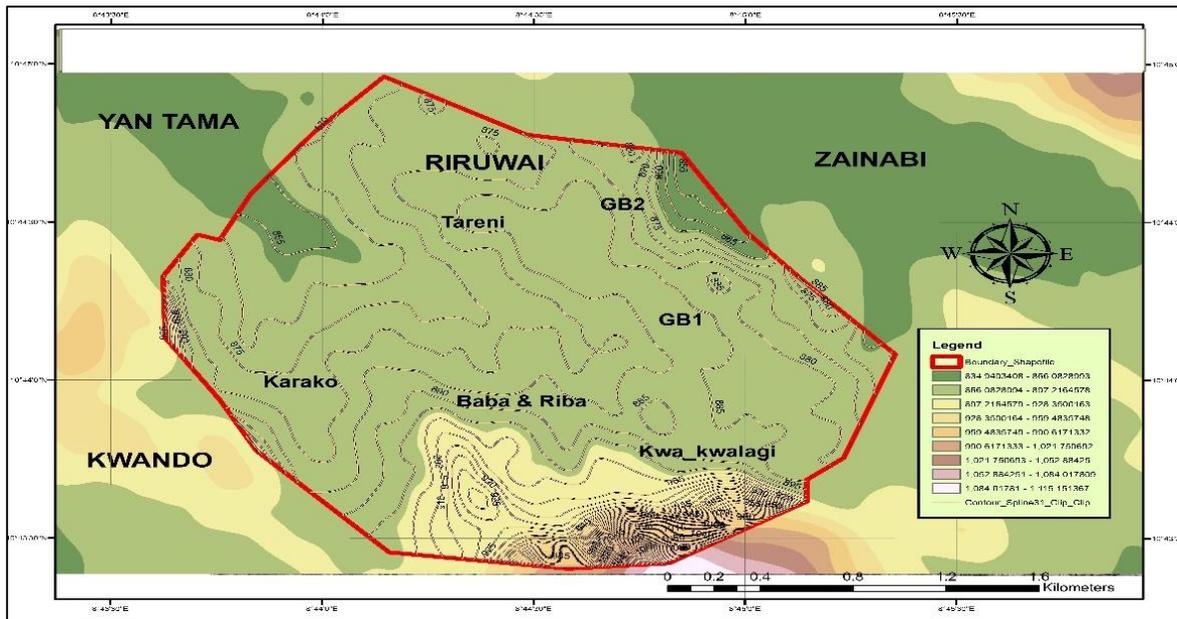
#### Likely Environmental Impact of Mining Activities

The environmental impact of mining activities comprises of a host of issues ranging from

deforestation, erosion, land degradation and pollution. The study revealed that in all communities where mining activities are carried out, large scale environmental related problems occur.

**Topographical and Relief Pattern**

In terms topography and relief, Riruwai has an outstanding elevation in the whole Kano region. It is the highest point above the sea level in the region rising up to about 1230 meters, but the average height is 1100meters.



**Figure 2** Topographical and Relief Pattern across Riruwai Kano State

**Vegetation Removal**

Mining activities requires the removal of a large area of topsoil, with related plants and wildlife, followed by digging to remove the resource below. Again, large tracts of agricultural lands are also destroyed as a result of excessive vegetation

removal and disturbance of soil structure. Another effect of mining on the environment is that topsoil is usually removed during mining, and the land is no longer able to support plant growth, in addition to being left exposed to erosion.



**Plate 1** Land Cleared For Mining Activities

### Land degradation

The miners leave behind poor landscapes consisting of unstable piles of waste, and abandoned excavations. Typically, they also left behind unfilled and abandoned excavated pits that become water bodies and become breeding grounds for mosquitoes and potential dangers to both humans and animals.

### Deforestation

Another effect or issue associated with mining and the environment is Deforestation. Mining requires large areas of land to be cleared in order to dig for these mineral resources and this means that large-scale of deforestation is required to be carried out in the areas where mining has to be done. Also, the cutting down of trees in itself is a big threat to a number of plants, trees, birds and animals that dwell in the forests. In addition, unregulated, uncontrolled and primitive methods applied in mining activities expose the large environment to deforestation.

### Impact on Water Bodies

Toxic and contaminated water are improper discharge or release in the environment especially in water bodies. It's does not only pollute the immediate environment or water bodies but also

effect plants, animals and the larger human population who depends on the water course. Most of the contaminated water are released into nearby water bodies, and are responsible for water pollution.

### Air pollution

In the mining of tin ore and columbines in the study area particles matter are released into the air. The concerns of the affected communities on air quality have been the dust particles matter, emissions of black smoke by burning of dead trees. Dust particles of major concern within the mining communities include respiratory dust. The activities that generate this particles matter include site clearance and road building, open-pit drilling, loading and haulage, and vehicular movement.

### Soil Erosion

High rate of deforestation, vegetation cover removal and surface run-off are the major causal factors of soil erosion, as large area of land is required for mining activities. Along the other impact, soil erosion cause a lot of effect to the physical environment of the study area such as loss of vast land loss of biodiversity and change the landscape of the existing environment.



**Plate 2** Land degradation    **Plate 3** Water pollution  
Source: Field survey, 2020

**Plate 4** Soil Pollution

**Table 1** Format of impact valuation matrix

MEDIUM		COMPONENT					
ACTIVITY AND/OR ACTION	IMPACT	LOCATION	VALUATION				
Project activity/action generating the impact	Net change caused by the activity/action on the component analyzed	Geographic location of the impact (segment, sector, locality or coordinates)	Ca	Re	Te	Ti	Mg
			Value of the impact as per predefined criteria (*)				

**Valuation criteria:** Ca= Character [+ , -]; Re= Reversibility [Reversible (Rev), Recoverable (Rec), Unrecoverable (Irr)]; Te= Timeframe [Temporary (Te), Permanent (Per)]; Ti=Type [Direct (Dir), Indirect (Ind), Synergistic (Sin), Cumulative (Acu)]; Mg= Magnitude [High (Al), Medium (Me), Low (Ba)]  
Source: MG Ambiental S. 2010

### Analysis of the Likely Environmental Impact

**Table 2** Checklist for identification and assessment of cumulative environmental impacts of mining activities in the mining site based on environment factors

Likely impacts	Yes/no/maybe and details	Resource or area to be affected	Past, present, or future actions that may contribute to the impact	Significant/ not significant? Why?
<b>Physical environment landform</b>	Yes: removal of vegetation and topsoil removal aided by natural rain fall and surface run off cause erosion of soil	All the Mine sites	Topsoil removal at other mines may contribute to soil erosion	Yes: the rate of erosion may be substantial and the impact is cumulative
<b>Change in land use</b>	Yes: land use within the lease area will be affected, as land will be acquired for mining purpose	Lease area	The combined effect of all the mines will result in change of existing land use in the entire area	Not likely: the change may be cumulative and interfere with future land use planning in the area
<b>Air</b>	Yes: air quality in the surrounding area may deteriorate due to particles emissions from a number of activities	Area lying within the air quality impact zone	The villages within the cumulative air quality impact zone will experience cumulative impact	Yes: the magnitude of the impact may be large and may extend or affect many receptors;however, mitigation of the impact is possible with known environmental management solutions
<b>Biological flora</b>	May be: the vegetation removal is likely to change the diversity and productivity of vegetation in the forestland	Forest land in all the mine sites in the study area.	Falling down of trees and removal of existing vegetation cause erosion and migration of biological flora	The impact is slightly significant and cause and very difficult to mitigate
<b>Impact forests</b>	Yes: vegetation removal cause reduction in the forestland	Reserve forests in the mine sites	None: other mines will not be located in forestland	yes: the change is very significant, localized, easy to mitigate, and no potential for cumulative impacts
<b>Number of species of bird and animal</b>	Yes: the area is inhabited by such wildlife	Reserve forests in the mine sites	The animals and bird species are impacted.	No: the changes is very small and easy to mitigate

Likely impacts	Yes/no/maybe and details	Resource or area to be affected	Past, present, or future actions that may contribute to the impact	Significant/ not significant? Why?
<b>Number of species of plant</b>	Yes: the area is cover by thick forest of different plant species.	Reserve forests in the mine sites	Rapid rate of cutting down of trees in the mine sites result to the deforestation.	Yes, the changes are very substantial and very easy to mitigate and have potential cumulative impacts
<b>impingement of animal life</b>	Yes: noise and vibrations may affect the animal life in the forest	Reserve forests in the mine sites	Similar effects from the other mines sites as animals are chase away.	Not likely: the combined level of noise and vibrations in the forests are likely to be low, localized, and easy to mitigate
<b>Migration of wildlife and interaction problem</b>	Yes: habitat reduction and barrier to their migration routes may cause wild life animals to migrate to the other areas	Reserve forests in the mine sites	Migration of wild life animals contributes to cumulative impacts in the area	Not likely; habitat reduction is small, localized, and non-cumulative

Source: MG Ambiental S. 2010

Table 2 indicated that deforestation, water pollution, air pollution and land degradation are the major environmental impacts related to mining activities in the study area. And the resultant impacts are very significant and difficult to mitigate. The study also revealed that the impact of deforestation and vegetation removal has force biological fauna and flora to migrate from the immediate environment, which is very significant impact and difficult to mitigate.

### Leopold Matrices

The main purpose of the Leopold Matrix is the identification of impacts and the determination of their magnitude and importance this method

project actions are related to environmental components. Actions are ranged horizontally (columns) and components are listed vertically (rows). The cells of the matrix, representing an interaction between a component and an action, are bisected diagonally. Impacts are investigated and scored subjectively by experts on a 1-10 scale of increasing importance or magnitude. The score for magnitude is placed in the top left-hand corner of each cell and the score for importance placed in the bottom right-hand corner. For example, a proposed development might reduce the water table over a wide area by a few centimetres. The magnitude score might be 8, but the importance score might be only two.

**Table 3** Leopold matrix for identifying and assessing likely environmental impacts of mining activities

PARAMETERS			Prospecting Stage												Mine Operation							
ENVIRONMENTAL COMPONENTS	MEDIUM	LIKELY IMPACTS																				
<b>Physical</b>	Air Quality	ICA1: Local, temporary and intermittent deterioration of air quality	-	-	-																	
	Noise	IR1 and IR2: Noise generation on receivers close to the mining site.															-					
	Land use and soil quality	S1: Removal and loss of soil surface in areas where mining are sited																-				
	pollution	Surface water pollution															-	-				
<b>Biotic</b>	Flora and vegetation	IFV1: Reduction in tree foliage coverage																-				
	Terrestrial vertebrate fauna	IF1: Alteration of habitat quality				-	-	-	-								-	-				
<b>Human</b>	Social Environment	IMS1: Generation of direct employment	+															-				
	Landscape	IP1: Alteration of visual quality of the landscape															-	-				
Note: (-) negative impact; (+) positive impact																						
			Contraction of labor force	transport of people or supplies	Operation of equipment	Circulation of people around	I and acquisition and creation	Clearing of construction sites	Particles moving	Construction of foundations	Piling of waste earth/rock	Assembly of structures and	Preparing the restricted zone	Tailings disposal	Closure/diversion of existing	Demobilization and cleanup of	Equipment and machine	Surface water pollution	Tonsoil and subsoil removal	Overburden removal and	Ore removal and loading at pit	Surface run off

Source; Author, 2020

However the study revealed that mining activities in the study area contribute positively as it reduces the level of unemployment in the study area.

Employment opportunity is the only positive impact identifying in the study area, as the mining site is considered degraded.

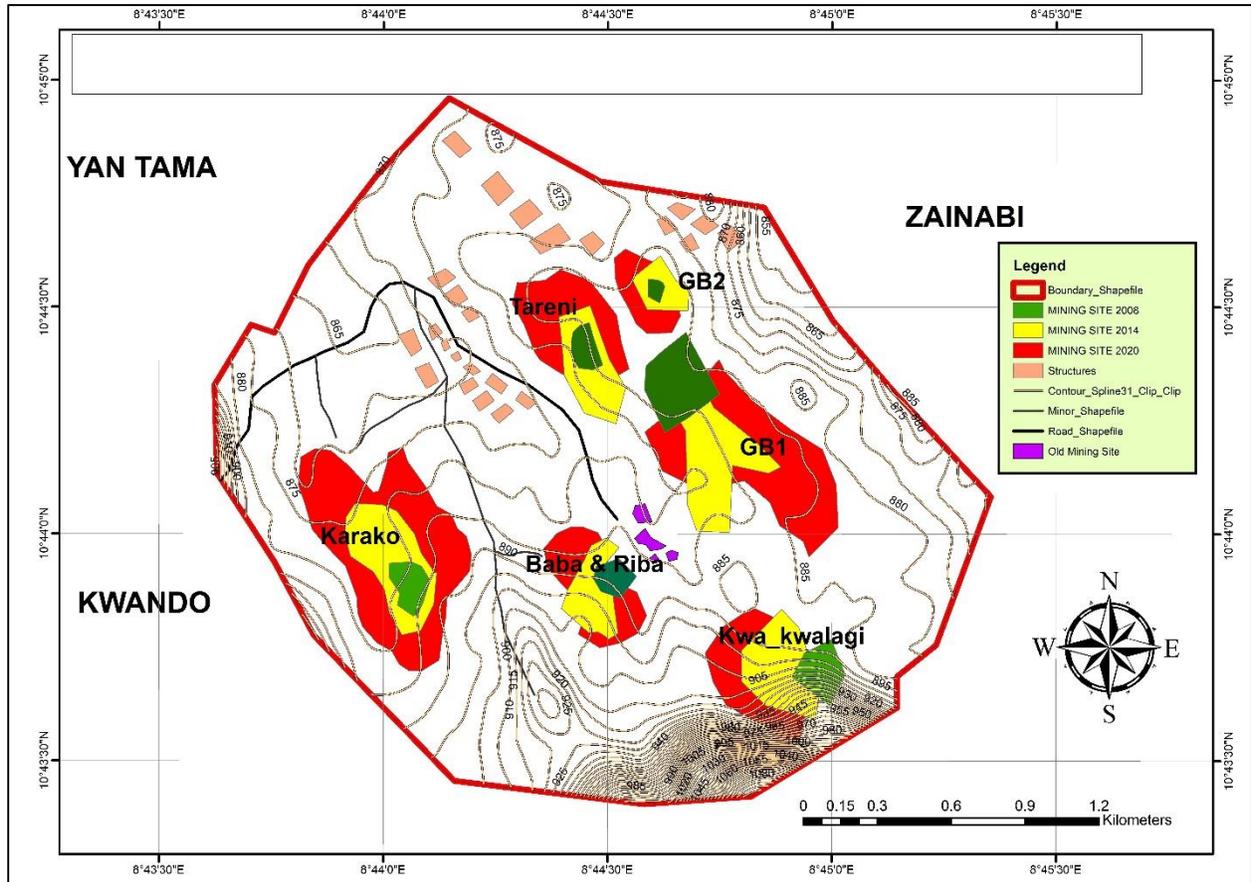


Figure 3 Overlay of the Mining Site

Spatial analysis of an Overlay of the mining sites

Table 4 Spatial extent of Karako mining site in 2008, 2014 and 2020

Years interval	Area (hectares)	Percentages (%)
2008	11.49	17.63
2014	22.45	34.45
2020	31.23	47.92
Total	65.17	100

Sources: Field survey, 2020

The study revealed that 17.63% of the total area of Karako mining site is degraded by the mining activities between 2008 and 34.45% is reported

between 2014 and also 47.92% in 2020 of the total land mass of the mining site reported to be significant impact.

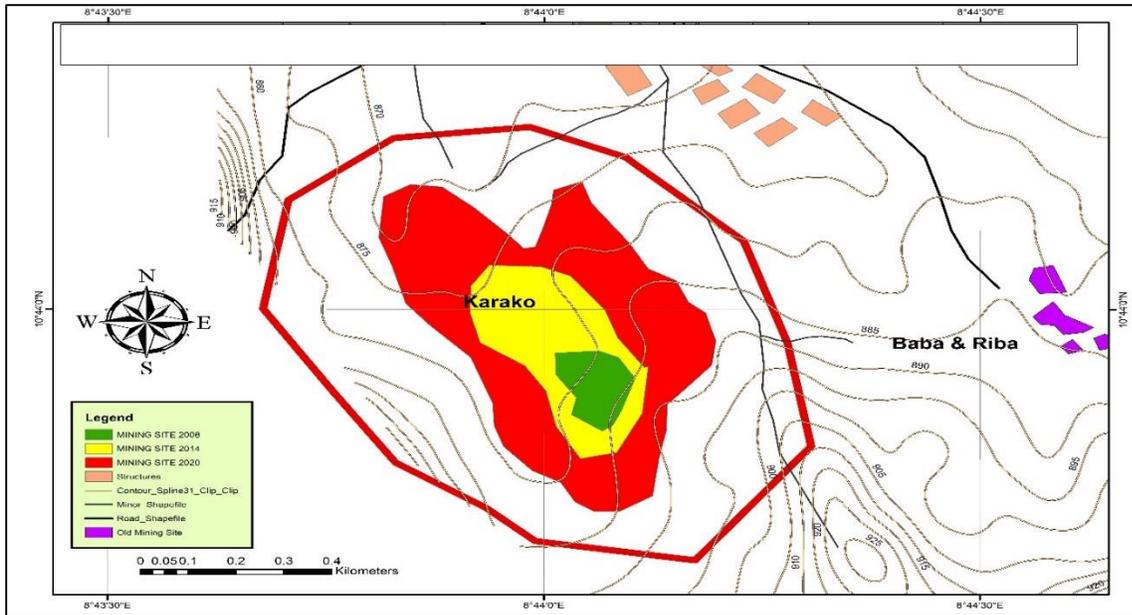


Figure 4 Overlay of Mining Activities across Karoka Riruwai, Kano State

Table 5 Spatial extent of Tareni mining site in 2008, 2014 and 2020

Years interval	Area (hectares)	Percentages (%)
2008	74.14	27.72
2014	96.28	36.00
2020	97.07	36.29
Total	267.49	100

Sources: Field survey, 2020

The study revealed that 27.72% of the total area of Tareni mining site is degraded by the mining activities between 2008 and 36.00% is reported

between 2014 and also 36.29% in 2020 of the total land mass of the mining site reported to be significant impact.

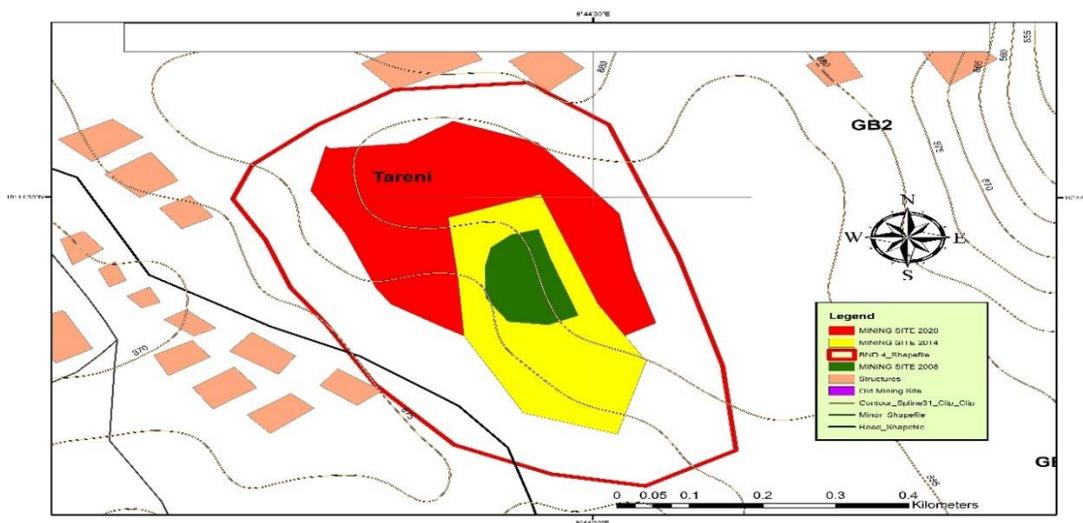


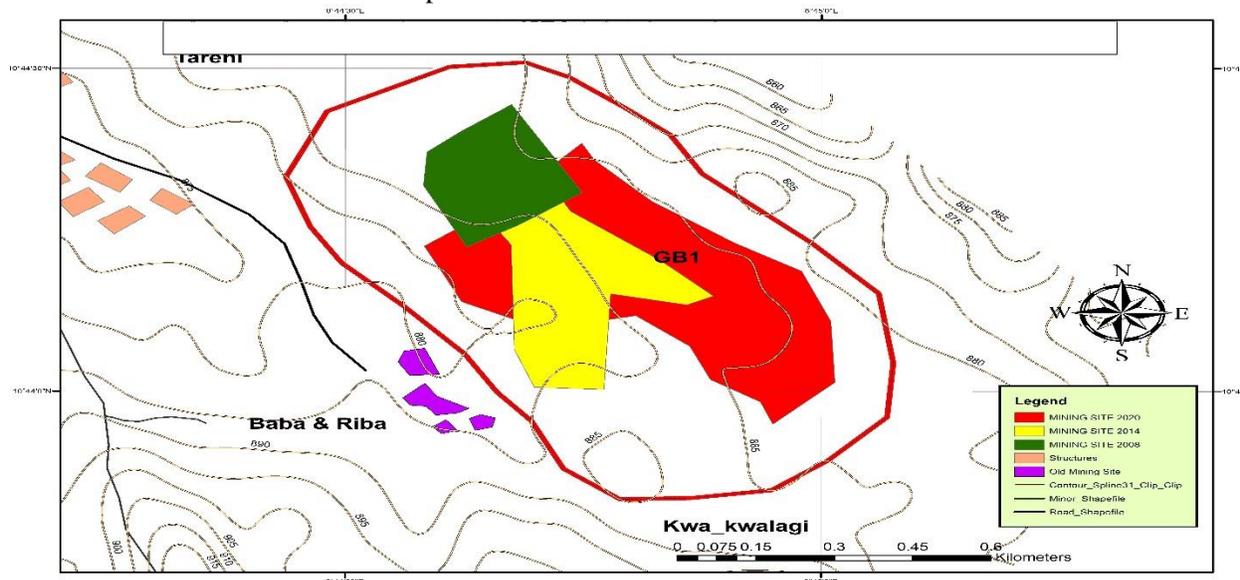
Figure 5 Overlay of Mining Activities across Tareni, Kano State.

**Table 6** Spatial extent of GB1 mining site in 2008, 2014 and 2020

Years interval	Area (hectares)	Percentages (%)
2008	63.22	18.91
2014	89.72	26.84
2020	181.31	54.24
Total	334.25	100

Sources: Field survey, 2020

The study revealed that 18.91% of the total area of GB1 mining site is degraded by the mining activities between 2008 and 26.84% is reported between 2014 and also 54.24% in 2020 of the total land mass of the mining site reported to be significant impact.



**Figure 6** Overlay of Mining Activities across GB1 Riruwai, Kano State

**Table 7** Spatial extent of Baba da Riba mining site in 2008, 2014 and 2020

Years interval	Area (hectares)	Percentages (%)
2008	6.86	11.71
2013	18.33	31.30
2020	33.37	56.90
Total	58.56	100

Sources: Field survey, 2020

The study reported that 11.71% of the total area of Baba da Riba mining site is degraded by the mining activities between 2008 and 31.30% is reported between 2014 and also 56.90% in 2020 of the total land mass of the mining site reported to be significant impact.

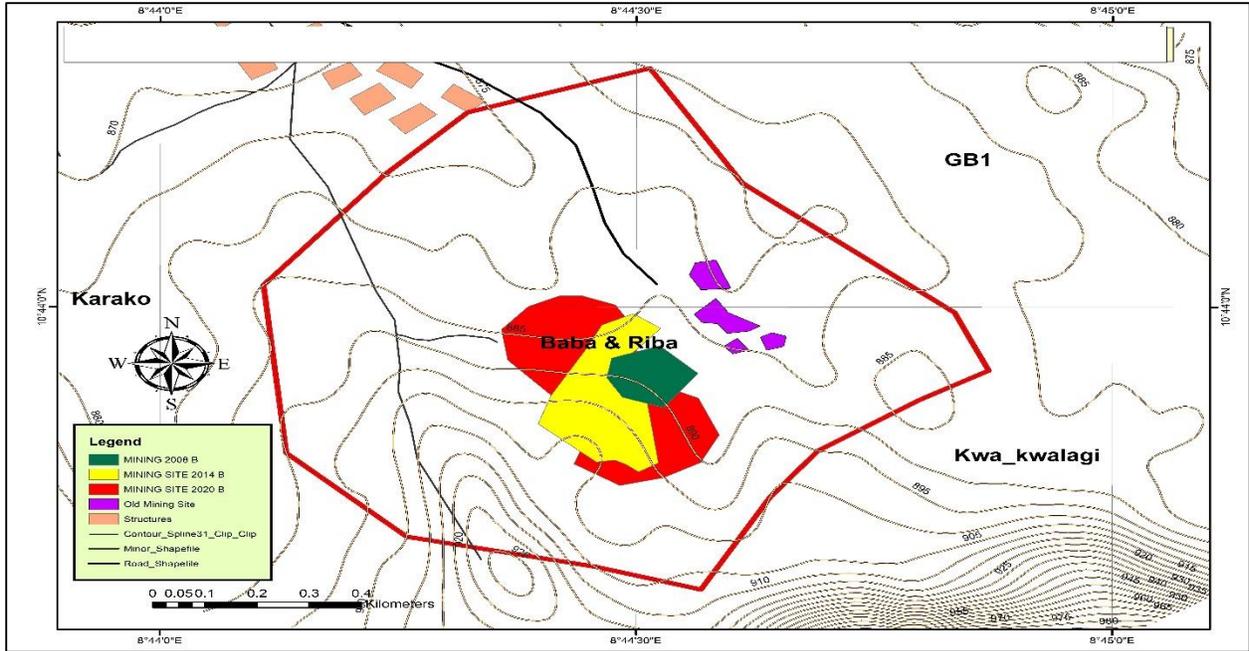


Figure 7 Overlay of Mining Activities across Baba and Riba Riruwai, Kano State

Table 8 Spatial extent of Kwa-Kwalagi mining site in 2008, 2014 and 2020

Years interval	Area (hectares)	Percentages (%)
2008	19.11	24.35
2014	24.70	31.48
2020	34.66	44.17
Total	78.47	100

Sources: Field survey, 2020

The study revealed that 24.35% of the total area of Kwa-Kwalagi mining site is degraded by the mining activities in 2008 and 31.48% is reported in 2014

and also 44.17% in 2020 of the total land mass of the mining site reported to be significant impact.

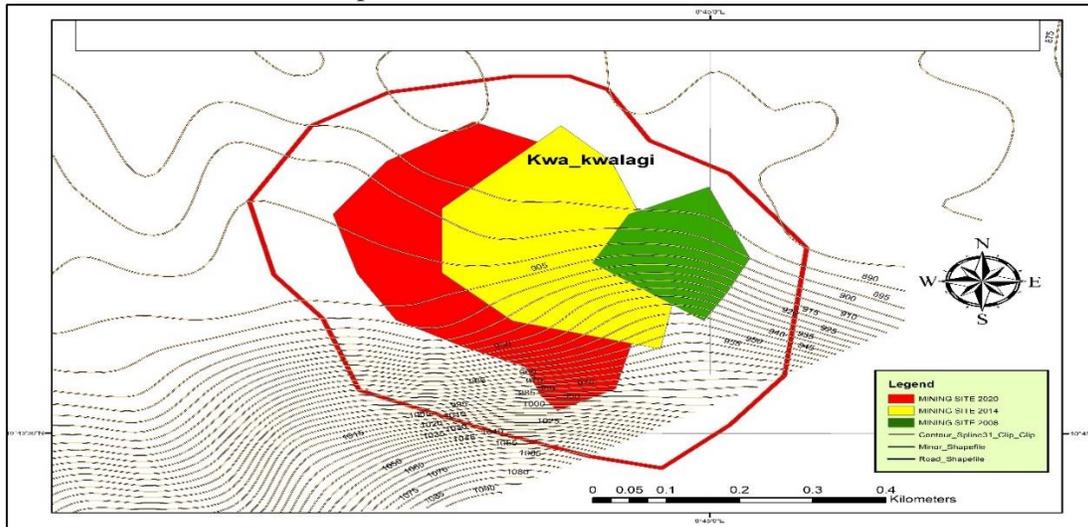


Figure 8 Overlay of Mining Activities across Kwa-Kwalagi, Riruwai, Kano State

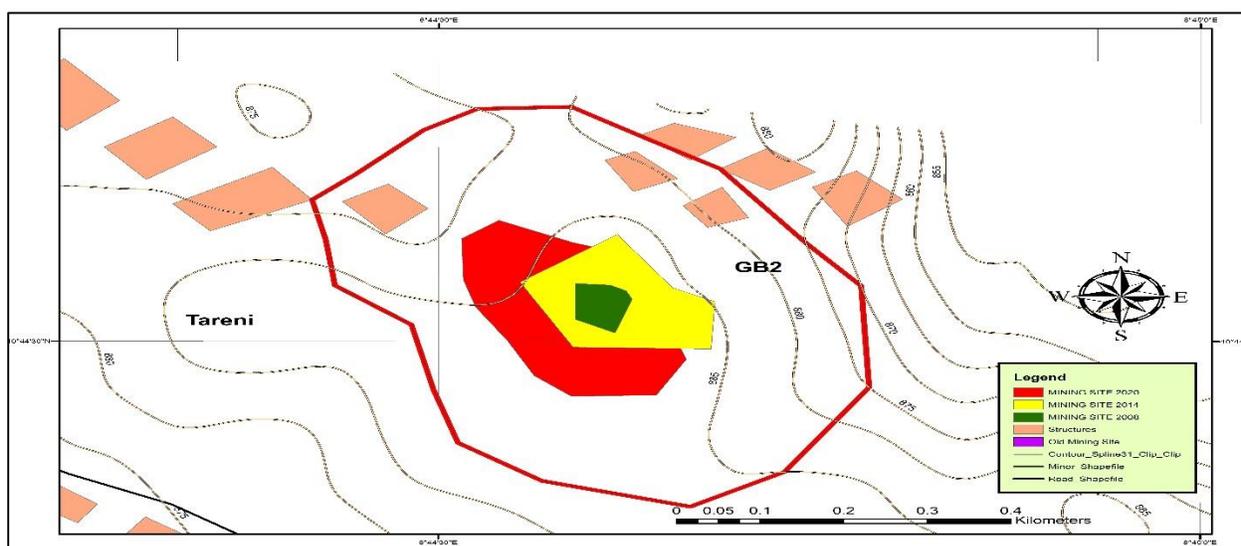
**Table 9** Spatial extent of GB2 mining site in 2008, 2014 and 2020

Years interval	Area (hectares)	Percentages (%)
2008	6.86	11.71
2014	18.33	31.30
22020	33.37	56.90
Total	56.25	100

Sources: Field survey, 2020

The study reported that 11.71% of the total area of GB2 mining site is degraded by the mining activities in 2008 and 31.30% is reported in 2014 and also

56.90% in 2020 of the total land mass of the mining site reported to be significant impact.



**Figure 9** Overlay of Mining Activities across GB2 Riruwai, Kano State

**Table 10** Overall spatial extent of impact of mining activities on the environment in the study area

S/N	MINING SITE	AREA (HECTARES)	PERCENTAGE (%)
1	Karako	65.17	7.58
2	Baba da Riba	58.56	6.23
3	Tareni	267.49	31.10
4	Kwa - kwalagi	78.47	9.12
5	GB1	334.25	38.86
6	GB2	56.25	6.54
	Total	860.19	100

Source: Field survey, 2020

The table above revealed that of all the mining sites Baba da Riba mining site reported 6.23% of the total area with less impact, while Kwa-kwalagi mining site with the average of 9.12% of the total area is impacted by the impact of mining activities and GB1 reported the highest impact of mining activities in the study area with 38.86% of the total area is degraded by the impact of mining activities.

## CONCLUSION

The tin ore and columbine mining in kwakwalagi mining site have, to a larger extent, tampered with most of the environmental resources particularly large tracts of land and forest cover since the mining operate in the areas is identifying local, temporary and intermittent deterioration of air quality, and noise generation on receivers close to the mining

site. Environmental problems such as deforestation, vegetation removal, erosion, loss of biodiversity, land degradation, water pollution, and water pollution as the likely identifying environmental impacts associated with mining activities in the study area. The study finds that of all the mining sites Baba da Riba mining site reported 6.23% of the total area with less impact, while Kwa-Kwalagi mining site with the average of 9.12% of the total area is impacted by the impact of mining activities and GB1 reported the highest impact of mining activities in the study area with 38.86% of the total area is degraded by the impact of mining activities. The study also finds out that there is inadequate involvement of the residents in decision making, and therefore public do not have an idea on the impact that mining activities is causing to their immediate environment.

Mining is indispensable to the economic development of countries endowed with mineral deposits. Existing literature highlight the world wide contributions made to industrial revolution as well as human development from mining activities. In Nigeria the contribution of minerals to economic development cannot be overlooked. The country's national flag recognizes the significance of mineral resources to the development of the country. However, it has been noted that extraction of mineral resources comes at a cost especially to communities within which mining activities take place. Given that mining takes precedence over any other form of commercial and domestic land use in Riruwai, the area within which mining take place are at the receiving end of problems if their plights emanating from mining activities are not properly handled. The purpose of this research was to assess the environmental impact of mining activities in Riruwai and their direct and indirect impacts to the local people and the environment. After a thorough investigation into the mining activities in Riruwai, it has come to light that mining activities have resulted in land degradation thus limiting land available for local food production especially given that the Riruwai community is made up mainly of peasant farmers. There are also incidences of pollution at its various forms namely water, noise and air pollution. Water pollution has affected the few water sources within the area given its arid climatic condition. Among the major river streams in Riruwai, river has been severely polluted by mining activities.

Recommendation have been framed around the all the forces at play in respect of mining activities and their impact to the environment, there should be enforcement of laws protecting the environment, encouragement of community members to embark on reforestation exercise, more public education through the media. Compensation should be given to the people whose land have been affected as a result of the mining activities. There is need for government to synchronize mining and environmental laws and policies in Nigeria so as to improve the conditions for the local communities and ensure economic, social and environmental sustainability

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Kalavathy, (2004) interrelationship that exist among water, air land human beings and other living creatures such as plants, animals and microorganisms

Pacific F. Achieng Ogola (2007) environmental impact on climate and landscape, interaction on material assets, and the cultural heritage.

Patterson, (1986) declined rapidly in tin mining due to the behavior of the market of tin and diversion of interest in Nigeria towards oil production and export

Shau, (2001) mining of Malachite at ancient Egyptians, Gold and Iron at Wales by the Romans and Turquoise in pre-Columbian America