SUSTAINABLE LAND USE AND RECLAMATION STRATEGIES IN ABANDONED MINE SITES OF KUBA TOWN AND ENVIRONS, BOKKOS LGA, PLATEAU STATE, NIGERIA

[1]REAGAN MAFULUL MANGUT, [2]MAMUDA ISIAKA

Department of Minerals and Petroleum Resources Engineering
Plateau State Polytechnic, BarkinLadi, Nigeria
E-mail: [1]reaganmangut@gmail.com, [2]mamudaisiaka@gmail.com

Abstract - Mining activities in Kuba town and its environs, Bokkos LGA of Plateau State, have resulted in significant environmental degradation, including abandoned mine ponds, soil erosion, and vegetation loss. These degraded landscapes pose risks to agriculture, water quality, and human safety. This study evaluates reclamation strategies aimed at restoring ecological balance and promoting sustainable land use.Field surveys, soil sampling, laboratory analysis, and community consultations were conducted across eleven (11) identified mine ponds (Kuba 1–4, Sangwak, Dan Bukuru, Blue Dam, Maiyanga, MaiyanganTsofo 1 & 2, and Fofai). Soil physical and chemical properties were assessed to determine suitability for reclamation. Results show near-neutral pH and moderate fertility but elevated levels of certain heavy metals such as cadmium and mercury.Based on site characteristics, tailored reclamation strategies were proposed, integrating physical rehabilitation (land reshaping, erosion control), biological restoration (re-vegetation with native species), and socio-economic reuse (agriculture, aquaculture, water supply, and eco-tourism). The study concludes that effective reclamation can transform degraded mine sites into productive landscapes, enhancing food security, livelihoods, and environmental sustainability, provided there is strong community participation and institutional support.

Keywords - Sustainable land Use, Reclamation, mine sites, Soil contamination, Heavy metals.

I. INTRODUCTION

Mining has historically contributed to economic development in Nigeria, particularly through tin and columbite extraction on the Jos Plateau. However, unregulated artisanal mining has left widespread environmental damage, especially in Kuba town and surrounding communities. The resulting impacts include abandoned pits and mine ponds, Soil degradation and erosion, Loss of vegetation and biodiversity, Disruption of natural drainage systems.These conditions reduce agricultural productivity and pose safety hazards. Reclamation is therefore essential to restore land to a stable and productive state.

Previous studies emphasize integrated approaches combining soil restoration, vegetation recovery, and community involvement. However, many mine sites in Plateau State remain unreclaimed due to limited site-specific data. This study addresses that gap by assessing soil conditions and proposing practical reclamation strategies.

II. STUDY AREA: LOCATION AND GEOLOGY

Kuba town lies between latitudes 9°21′N, 9°26′N and longitudes 8°54′E,9°01′E, with elevations reaching 1,430 m. The area is accessible via the BarkinLadi–Bokkos road and connected by feeder roads to mining communities. The climate is tropical with rainfall: 1200–1400 mm annually and Temperature: 18°C–27°C. Vegetation is Guinea Savanna but heavily disturbed by mining. Geologically, the area belongs to the Jos Plateau, underlain by Precambrian Basement Complex rocks intruded by Younger Granites rich in tin and associated minerals.

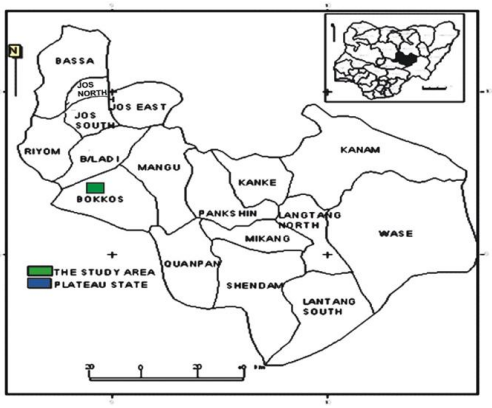


Fig. 1: An Outline Map of Plateau State Showing the Study Area.

Geologically, the area lies within the Jos Plateau, underlain by Precambrian Basement Complex rocks intruded by Younger Granites (Figure 2). The granitic rocks are rich in tin, columbite, and associated minerals, which explains the intensive mining in the area.

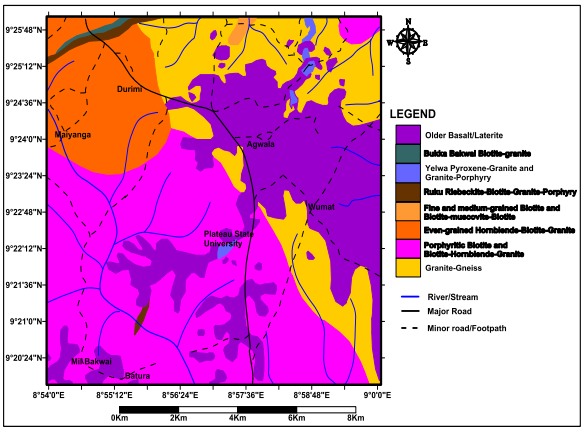


Fig.2: Modified Geologic Map of Kuba and Environs (After Macleod, 1976)

III. MATERIALS AND METHODS

3.1 Field Investigation

A reconnaissance survey identified eleven (11) major abandoned mine sites. GPS mapping, photography, and oral community interviews were used to document:Land degradation, Vegetation cover, Water-filled pits, Erosion patterns.

3.2 Soil Sampling and Laboratory Analysis

Soil samples were collected at depths of 0–100 cm and analyzed for Physical properties to include pH, bulk density, moisture, porosity, EC and Chemical properties for heavy metals. (As, Cd, Pb, Hg, Cr, Zn, Cu, Mn, Fe). Laboratory tests were conducted using standard methods using Atomic Absorption Spectrophotometry (ASS).

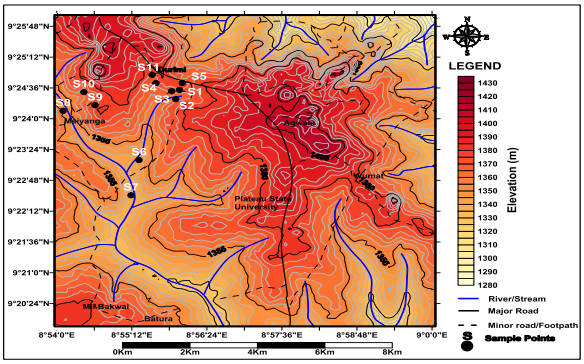


Fig 2: Map of Kuba and Environs showing Sampling Points, elevation and concentration of Mining Ponds

3.3 Data Analysis

Results obtained from the analysis of samples were compared with WHO standards to evaluate soil fertility, environmental safety and suitability for reclamation

IV. RESULTS AND DISCUSSION

4.1 Field Results

The study area shows severe degradation, open pits (2–8 m deep), water-filled mine ponds Sparse vegetation and active erosion. Most sites are located close to settlements and farmlands (Table 1), increasing exposure to hazards.

S/N	Location	Location Code	Spatial Distribution of abandoned Mine sites		
			Nothing	Easting	Elevation (m)
1	Kuba 1	KB1	09° 24’ 34.1’’	008° 55’ 59.6’’	1382
2	Kuba 2	KB2	09° 24’ 23.1’’	008° 55’ 54.1’’	1372
3	Kuba 3	KB3	09° 24’ 32.4’’	008° 55’ 50.0’’	1380
4	Kuba 4	KB4	09° 24’ 41.8’’	008° 55’ 34.8’’	1379
5	Blue Dam	BD	09° 24’ 42.0’’	008° 55’ 59.9’’	1382
6	Sangwak	SG	09° 23’ 12.0’’	008° 55’ 18.7’’	1350
7	Dan Bukuru	DB	09° 22’ 30.9’’	008° 55’ 10.9’’	1344
8	Maiyanga	MY	09° 24’ 09.4’’	008° 54’ 05.8’’	1361
9	MaiyangaTsofo 1	MT1	09° 24’ 16.0’’	008° 54’ 36.4’’	1383
10	MaiyangaTsofo 2	MT2	09° 24’ 31.3’’	008° 54’ 25.6’’	1371
11	Fofai	FF	09° 25’ 09.3’’	008° 56’ 31.1’’	1360

Table 1: Table showing the spatial distribution of abandoned mine sites in Kuba and environs.

4.2 Soil Physical Properties

Results (Table 2) indicate: pH values of 6.8–7.2 (favorable for crops), moderate moisture and porosity and low to moderate organic carbon. These conditions suggest generally good agricultural potential but require improvement in organic matter and soil structure.

S/N	Parameters	P^H	B.D (g/cm^3)	MC (%)	E.C (ds/cm)	Porosity (%)	T.O.C (%)	
1	K1	6.85	2.00	20.00	0.50	24.53	0.02	
2	K2	6.90	1.82	18.00	0.50	30.00	0.05	
3	K3	7.00	1.82	16.00	0.50	29.70	0.08	
4	K4	7.20	1.33	14.00	0.50	50.37	0.20	
5	BD	6.80	1.82	12.00	0.55	31.06	0.42	
6	SG	7.10	2.00	4.00	0.50	24.81	0.64	
7	DB	6.80	1.90	10.00	0.61	28.57	0.08	
8	MY	6.90	1.54	12.00	0.60	41.89	0.42	
9	MT1	7.20	1.90	8.00	0.58	28.30	0.74	
10	MT2	6.80	2.00	16.00	0.65	24.53	0.40	
11	FF	6.90	1.96	10.00	0.72	25.76	0.20	

Table 2:Results of Physical Analysis of Soil Samples of abandoned mine sites in Kubaand environs.

4.3 Soil Chemical Properties

Heavy metal analysis (Table 3) reveals Cadmium (Cd) to be above WHO safe limits with potential health risk. Mercury (Hg) is elevated and toxic to plants and water, Copper (Cu) isslightly above safe levels and Lead (Pb), Zinc (Zn), Manganese (Mn) are all within WHO acceptable limits. There exist contamination risks, especially for groundwater and food safety, requiring controlled remediation.

S/N	Samples	AS	Cd	Pb	Hg	Cr	Zn	Cu	Mn	Fe
1.	K1	4.60	5.70	5.40	12.50	100.60	7.20	200.70	76.50	230.20
2.	K2	4.60	82.70	5.00	8.60	95.10	86.60	197.20	75.20	237.00
3.	K3	3.10	70.80	5.90	4.60	97.90	84.10	199.30	73.10	152.7
4.	K4	4.70	41.30	5.40	27.10	89.20	90.30	197.60	74.30	153.90
5.	BD	3.80	84.00	6.60	14.60	84.20	4.50	202.60	152.80	151.70
6.	SG	5.40	77.50	10.10	7.90	35.70	77.50	110.00	74.20	76.40
7.	DB	8.10	70.50	19.40	13.70	37.60	82.10	205.40	74.0	149.10
8.	MY	5.70	76.00	10.60	7.90	108.20	84.10	101.60	78.20	243.70
9.	MT1	11.20	71.10	9.90	4.88	104.80	76.00	107.80	152.20	234.90
10.	MT2	3.90	44.40	11.00	2.50	106.80	73.50	104.40	149.90	263.20
11.	FF	5.20	42.00	8.90	15.90	53.20	75.30	106.30	76.20	163.50

Table 3: Results of Chemical Analysis of Soil Samples of abandoned mine sites in Kuba and environs.

4.4 Field Evidence (Plates)

Field photographs showsextensive environmental land degradation characterize by erosion.



Plate 1: Extensive environmental land degradation characterize by erosion in the Study Area.



Plate 2: Soil Sampling and soil erosion control measures on the field.

V. PROPOSED RECLAMATION STRATEGIES

5.1 Site-Specific Land Use Planning

Each pond is assigned based on suitability:

Site	Proposed Use
Kuba 1–4	Aquaculture & irrigation
Sangwak, Dan Bukuru, FofaiAgriculture	
Blue DamEco-tourism	
Maiyanga, MT1 & MT2Water supply	

5.2 Physical Reclamation

Key measures include, backfilling shallow pits, slope stabilization and terracing, drainage construction, Erosion control (bunds, check dams) and road/access improvement

5.3 Biological Reclamation

Vegetation restoration using trees like Neem, Acacia, Eucalyptus, grasses: Vetiver, Elephant grass, planting of wetland plants for water purification and organic manure to improves soil fertility and supports regeneration.

5.4 Sustainable Land Use Integration

Proposed land uses include Community fish farming, Irrigated agricultureEco-tourism development and Domestic water supply. These create economic opportunities while maintaining environmental balance.

VI. CONCLUSION AND RECOMMENDATIONS

The study confirms that mining activities have significantly degraded the Kuba environment. However, the area retains strong potential for recovery through integrated reclamation. It can be concluded that Soil conditions are moderately suitable for reclamation, Heavy metal contamination in soil requires management and site-specific strategies to enhance sustainability.Therefore,agriculture and aquaculture using reclaimed ponds can be recommended, development of eco-tourism at scenic sites like Blue Dam, implementation of continuous environmental monitoringensuring community participation in all reclamation phases, provide government and institutional support and development of a comprehensive reclamation policy framework

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