



Assessment Of Precious Mineral Deposits and Their Socio-Economic Significance in Maru Local Government Area, Zamfara State, Nigeria

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ABSTRACT

This study assessed precious mineral deposits and their socio-economic significance in Maru Local Government Area (LGA), Zamfara State, Nigeria. Maru LGA (approx. Lat. 12°33'N, Long. 6°40'E) lies within the Maru Schist Belt of the north-western Nigerian Basement Complex, a well-documented metallogenic province for gold and associated rare-metal pegmatites. Data were obtained through a review of geological maps and literature, field observation, and administration of a structured questionnaire to 100 artisanal miners and mineral traders purposively selected from Maru, Malele, Dansadai, Dan Marke, Ruwan Doruwa and Kadauri. Ninety-nine questionnaires were returned and analyzed using descriptive statistics. Results identified economically significant deposits including gold (Au), tantalite [(Fe,Mn)Ta₂O₆], columbite [(Fe,Mn)Nb₂O₆], chromite (FeCr₂O₄), limestone (CaCO₃) and granitic aggregates. Gold remains the dominant commodity, with active artisanal exploitation and well-established local market chains extending to Gusau. Socio-economic analysis revealed that 52.5% of respondents are directly engaged in mining and 78% depend on mining-related activities as a primary or major secondary source of income. Reported benefits include employment generation (especially for youth), settlement expansion, growth of ancillary businesses, and increased household income. However, 66.7% reported occupational hazards (pit collapse, venomous animal encounters, inter-group conflicts), while 100% expressed dissatisfaction with current artisanal methods due to low productivity, lack of geological identification tools, absence of standard safety measures, and environmental degradation including land degradation and erosion of farmlands. 84.9% reported no chemical use, while 15.1% reported use of explosives locally called 'nakia' (ammonium nitrate-based). 57.6% use digital scales (grams) for measurement, while 42.4% still rely on non-standard measures. The study highlights the paradox of resource wealth and underdevelopment: despite significant mineral endowment, benefits are constrained by informality, rudimentary technology, absence of institutional support (78.8% reported no government training/assistance), and linkages to insecurity. The paper recommends formalization of artisanal mining, provision of modern exploration and safety equipment, establishment of mineral buying centers with standardized assay, geochemical mapping of the Maru Schist Belt, and enforcement of environmental reclamation policies coupled with miner education programs.



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1.0 INTRODUCTION

Nigeria is endowed with over 44 identified solid mineral types distributed across more than 500 locations, yet the contribution of solid minerals to GDP remains below 1% (Obaje, 2009; Ministry of Mines and Steel Development, 2016). Zamfara State, located in north-western Nigeria, is recognized as one of the most mineral-endowed states, hosting more than 120 artisanal mining sites with proven occurrences of gold, tantalite, columbite, iron ore, baryte, limestone and granite (Shaibu, 2018; Salisu, 2010). Within Zamfara, Maru Local Government Area, the largest LGA by landmass, lies within the Maru Schist Belt, one of eight N-S trending schist belts in western Nigeria known for gold and rare-metal pegmatite mineralization (Ajibade *et al.*, 1976; Garba, 2003).

Precious minerals are defined as naturally occurring inorganic substances that are rare, chemically stable, and possess high economic value due to demand for jewelry, investment, and high-technology applications (Renner *et al.*, 2019). In strict metallurgical terms, precious metals include eight elements: gold (Au), silver (Ag), and the six platinum-group metals (PGMs) – platinum (Pt), palladium (Pd), rhodium (Rh), iridium (Ir), ruthenium (Ru) and osmium (Os) (Cowley, 2020). Base metals (e.g., copper, lead, zinc, iron) contrast with precious metals in their relative abundance, lower unit value, and susceptibility to corrosion. In the Nigerian context, and in this study, the term is used broadly to include gold and associated economically valuable industrial minerals such as tantalite, columbite, and chromite that co-occur in pegmatite and alluvial systems of Maru (Balaram, 2019).

Artisanal and Small-Scale Mining (ASM) dominates exploitation in Maru. ASM is characterized by low mechanization, labor-intensive methods, and informal market structures (Hilson & McQuilken, 2014). In Zamfara, ASM became intensified after 2009 following high gold prices and rural livelihood pressures, but it has also been associated with severe environmental and public health crises, notably the 2010 lead poisoning outbreak linked to unsafe gold processing, and more recently with insecurity and banditry linked to unregulated mining (Lo *et al.*, 2012; The Nation, 2021; WikiTimes, 2023).

Despite these challenges, gold mining in Maru LGA remains a livelihood anchor. Local reports indicate

that in communities such as Kadauri, Daki Takwas and Dansadau, mining is embedded in everyday economic life, with gold sold through local dealers to major markets such as Gusau Polo Shopping Complex and cross-border traders (The Cable, 2021; HumAngle Media, 2022). However, empirical assessment of what minerals occur, where they are concentrated, and how they translate into socio-economic outcomes at the LGA level remains fragmented.

1.1 Problem Statement and Objectives

Previous studies have focused on regional geology and geochemistry of the Maru belt (Garba, 2003; FUDMA Journal of Sciences, 2023) or on health and security dimensions of Zamfara mining (Lo *et al.*, 2012; Daily Advent, 2022), but integrated socio-economic assessment at community level in Maru is limited. Local miners lack modern tools for mineral identification, rely on crude extraction methods, and operate without standardized measurement or marketing systems, limiting value capture and increasing hazards.

The general objective of this study is to assess precious mineral deposits in Maru LGA and analyze their socio-economic significance. The specific objectives are to: (i) identify the types and spatial distribution of precious/strategic minerals in selected districts of Maru; (ii) examine the socio-economic benefits and livelihood dependence on mining; (iii) evaluate methods, tools and marketing practices used by artisanal miners; and (iv) identify challenges and recommend policy interventions.

2.0 Study Area and Geological Setting

Maru LGA is located between latitudes 12°20'N – 12°45'N and longitudes 6°20'E – 6°55'E, sharing boundaries with Bungudu, Gusau LGAs, and parts of Kebbi and Kaduna States. It is the largest LGA in Zamfara by area, with its headquarters in Maru town. The climate is Sudan savanna with a distinct wet and dry season, influencing seasonal alluvial mining.

Geologically, Maru is underlain by Precambrian Basement Complex rocks comprising migmatite-gneiss, granites, schists and quartzites, intruded by Pan-African granitoids. The Maru Schist Belt is a supracrustal assemblage with dominant schistose lithologies, amphibolites, and pegmatites that host gold-bearing quartz veins and rare-metal mineralization (tantalite-columbite) (Ajibade *et al.*, 1976; Obaje, 2009). Gold mineralization is both primary (quartz veins, disseminated in schist) and secondary (alluvial placers in river channels around Dansadau

and Maru), which explains the predominance of alluvial panning methods observed.

3.0 Literature Review

3.1 Gold and Associated Minerals

Gold (Au, from Latin Aurum) is a soft, dense (19.3 g/cm³), highly malleable and ductile metal, chemically inert and resistant to tarnishing (Weaver, 1886; Cowley, 2020). One gram can be drawn into 1.6 km of wire or hammered into 0.000076 mm foil. It is found as native gold in quartz veins and as alluvial nuggets. In Zamfara, gold occurs in association with lead-zinc sulfides, which was implicated in the 2010 lead poisoning tragedy when crude grinding released lead dust (Lo *et al.*, 2012).

Tantalite [(Fe,Mn)Ta₂O₆] and Columbite [(Fe,Mn)Nb₂O₆] are oxide minerals of tantalum and niobium respectively, often occurring together as coltan in pegmatites. They are critical for electronics due to high capacitance and heat resistance (Balaram, 2019). Chromite (FeCr₂O₄) is the primary ore for chromium used in stainless steel. Granite and limestone are industrial rocks used for construction and cement, but also represent important revenue streams for Maru.

3.2 Artisanal Mining and Socio-economic Dynamics in Zamfara

Hilson and McQuilken (2014) argue that ASM in sub-Saharan Africa serves as a poverty-driven safety net, absorbing youth unemployment but trapping miners in low-productivity cycles. In Zamfara, an estimated 10,000 illegal miners operated in 2012 alone (Vanguard, 2012). Maru and Anka LGAs are epicenters, with studies showing that 80% of miners operate informally under profit-sharing arrangements with land owners or sponsors (Good Governance Africa, 2020). The economics favor use of underage labor due to cheap labor and ease of entry at alluvial sites (The Nation, 2021).

Socio-economic benefits reported include income diversification, growth of settlements around mining sites (e.g., Kadauri gold field), and development of trading networks (The Cable, 2021). However, negative externalities include farmland degradation, deforestation, mercury/lead contamination, and conflict financing (WikkiTimes, 2023). The lack of formal buying centers leads to undervaluation; miners historically sold gold by non-standard 'seals' rather

than grams, though digital scales are now increasingly used in Maru (ZSM, 2009).

4.0 Research Methodology

Research Design: A descriptive cross-sectional survey design was adopted to combine geological review and socio-economic inquiry.

Population and Sampling: The target population comprised artisanal miners, mineral traders, traditional authorities and LGA officials involved in solid minerals in Maru. Due to the dispersed and informal nature of ASM, purposive and simple random sampling was employed. One hundred (100) respondents were selected across six mining communities: Maru town, Malele, Dansadau, Dan Marke, Ruwan Doruwa and Kadauri, representing major gold and tantalite/columbite fields.

Instrumentation: A 20-item structured questionnaire was developed covering (a) demographic characteristics, (b) knowledge of mineral types and locations, (c) involvement in mining, (d) methods and tools, (e) measurement and marketing, (f) perceived economic benefits and hazards, and (g) institutional support. For illiterate respondents, the instrument was administered in interview mode in Hausa. Validity was established through supervisor review (Dr. Bello Umar Gusau) and pre-test with 10 miners in Gusau.

Data Collection: Data included secondary data (geological map of Zamfara, literature) and primary data (field observations, questionnaire). Field work was conducted in 2009. 99 out of 100 questionnaires were returned (99% response rate).

Data Analysis: Data were coded and analyzed using simple percentages and frequency tables. Spatial occurrence was mapped descriptively. Ethical consideration: oral consent was obtained, and anonymity assured.

5.0 Results and Presentation

5.1 Demographic Profile: Of 99 respondents, 93.9% were male and 6.1% female, reflecting gendered labor division in hard-rock and pit mining (Table 1). Age distribution showed dominance of youth: majority were aged 20-29 years, followed by 30-39 years, indicating mining as a youth livelihood. Marital status: 43.4% single, 43.4% married, 13.1% divorced. Educational attainment: 48.5% had no formal education, 31.3% secondary, 20.2% tertiary – highlighting low literacy and need for training in mineral identification.

Occupation: 25.3% civil servants, 21.2% business persons, 27.3% farmers (dry season miners), and 26.3% students, confirming mining as a secondary income source and seasonal safety net.

5.2 Mineral Types and Spatial Distribution

Respondents identified gold in Maru (11 mentions), Dansadau (2), Dan Marke (1), Kadauri (1); granite in Maru (12) and Ruwan Doruwa (1); tantalite in Maru (2) and Dansadau (15); chromite in Dansadau (4) and Ruwan Doruwa (8); columbite in Maru (2). This pattern aligns with known geology: Maru town is central trading point but Dansadau–Ruwan Doruwa axis is rich in rare-metal pegmatites, while gold is widespread but concentrated in Kadauri and Dansadau alluvial fields (Garba, 2003; The Nation, 2021). Formalized summary is presented as Table 6.

Table 6: Reported mineral occurrence (multiple responses)

1.MINERAL DEPOSIT	AREA FOUND				
	MARU	DANSADAU	DANMARKE	RUWAN DORUWA	KADAURI
GOLD	11	2	1	-	1
GRANITE	12	1	-	1	-
TANTILITE	2	15	-	-	-
CHROMITE	-	4	-	8	-
LIMESTONE	2	-	-	-	-
CLOMBITE	2	-	-	-	-

5.3 Mining Involvement, Methods and Marketing

52.5% reported active involvement in mining; 47.5% were traders, transporters or observers. Tools were rudimentary: shovels, axes, diggers, trowels, hammers, and head pans. No respondent (100%) reported use of geological prospecting tools (magnetometer, panning loupe, assay kits) for identification – mineral recognition was based on experience and color/luster.

Chemical use: 84.9% reported no chemical use; 15.1% reported use of explosives called locally 'nakia' (likely ammonium nitrate fuel mixture) coupled with battery ignition to break hard rocks. No mercury/cyanide use was reported in this sample, though literature documents mercury use in Zamfara gold amalgamation (Lo *et al.*, 2012).

Measurement: 57.6% now use digital scales reading in grams; 42.4% still use non-standard local measures. Respondents cited historical price of N300 per gram in 2009 (ZSM, 2009), but current prices have risen sharply with global markets, indicating need for updated market information systems.

Marketing: 66.7% reported existence of marketing chain: pit → local dealer in Maru → Gusau (Polo Shopping Complex) → regional/export dealers. 33.3% sell directly at pits to itinerant buyers, often at lower prices, indicating value-chain exploitation.

5.4 Socio-economic Benefits and Challenges

Economic benefits: 63.6% affirmed that communities benefit economically; mining contributes to employment, settlement growth and ancillary services (food vending, motorcycle transport, equipment rental). This aligns with Good Governance Africa (2020) estimate that 80% of livelihoods in mining villages depend on ASM.

Hazards: 66.7% reported hazards including pit collapse, flooding during rainy season, snake/scorpion bites, dust inhalation, and inter-group conflicts over claims. 33.3% reported no hazard, possibly due to trading rather than digging roles.

Satisfaction and Support: 100% expressed dissatisfaction with current system due to low

recovery, environmental damage to farmlands (erosion, de-vegetation) and lack of support. 78.8% reported no training or financial assistance from state/local government; 21.2% reported occasional loans.

6.0 Discussion

The findings confirm that Maru LGA hosts economically viable precious and industrial minerals within the Maru Schist Belt, consistent with Obaje (2009) and Ajibade et al. (1976). The spatial pattern – gold ubiquitous but concentrated in Kadauri/Dansadau, tantalite-columbite-chromite in Dansadau/Ruwan Doruwa – reflects primary pegmatite and schist-hosted veins reworked into alluvial deposits.

Socio-economically, mining is a double-edged sword. On one hand, it provides critical income in a region with limited formal employment and high youth population, supporting settlement agglomeration and local commerce, as also observed in Anka LGA (HumAngle, 2022). On the other hand, the predominance of informal, low-tech methods results in low productivity, high risk, and environmental externalities. The lack of identification tools explains why high-value minerals like tantalite are often mistakenly sold as low-value ores, reducing community benefits.

The shift from local 'seal' measurement to digital gram scales is a positive development for transparency, yet without standardized assay (purity testing), miners remain price takers. The marketing chain Maru → Gusau → foreign dealers mirrors the 'blood gold' value chain described by The Cable (2021) and WikkiTimes (2023), where value addition occurs outside the community.

Institutional gap is glaring. The absence of extension services, geological survey presence, and environmental regulation enforcement perpetuates the cycle of rudimentary mining and land degradation. This is compounded by insecurity, which deters formal investment and leaves ASM under control of informal sponsors (Good Governance Africa, 2020).

Coherence argument: The resource curse at micro-level – Maru is mineral-rich but development-poor because informality, lack of human capital (48.5% illiterate), and absence of governance prevent translation of geological endowment into sustainable development. Formalization, as advocated by Hilson & McQuilken (2014), would require not only

licensing but also provision of low-cost beneficiation technology, safety training, and environmental reclamation funds.

7.0 Conclusion

This study demonstrates that Maru LGA is significantly endowed with gold, tantalite, columbite, chromite, granite and limestone, with gold being the most socio-economically important. Mining contributes substantially to livelihoods but is constrained by rudimentary techniques, lack of geological knowledge, absence of institutional support, and environmental and safety hazards. The paradox of wealth amidst poverty persists due to informality and weak value-chain integration.

8.0 Recommendations

1. Formalization and Mapping: Zamfara State Ministry of Solid Minerals, in collaboration with Nigerian Geological Survey Agency, should conduct detailed geochemical mapping and establish a mineral database for Maru Schist Belt.
2. Establishment of Buying Centers: Government-licensed mineral buying centers with assay facilities in Maru and Gusau to ensure fair pricing by gram and purity.
3. Technology and Training: Provide artisanal miners with affordable tools – sluice boxes, shaking tables, protective gear – and training on mineral identification, safe pit construction, and environmental reclamation. Target youth and women through adult literacy integration.
4. Environmental Policy Enforcement: Enforce Environmental Impact Assessment and pit backfilling regulations; introduce community environmental monitoring committees.
5. Financial Inclusion: Facilitate cooperative societies for miners to access micro-credit and equipment leasing.
6. Security and Governance: Strengthen community-based security and formalize ASM to delink mining from conflict financing, as recommended by Good Governance Africa (2020).

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