

Evaluation of artisanal and small-scale mining conditions in Nigeria with respect to the sustainable development goals of the UN: Identification of key performance indicators

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In recent years, there have been actions to improve the performance of artisanal and small-scale mining (ASM) in Nigeria by the World Bank and the government of Nigeria. However, due to the poor understanding of the sector's dynamics, all efforts have failed to deliver effective performance. In the meantime, the Sustainable Development Goals (SDGs) from the United Nations' 2030 Agenda provides a framework to help build such an understanding to provide a set of overall objectives, targets, and associated indicators to assess the progress countries are making towards broad-based sustainable development.

Therefore, this work aims to develop a new framework from the World Bank's existing key performance indicators (KPIs), together with realistic challenges that govern ASM in Nigeria. This scheme includes the determination of 17 updated and new KPIs for improving ASM conditions in Nigeria upon progress towards varieties of related SDGs. The framework utilises evaluation techniques and performance management tools such as SMART to assess the prioritisation and level of significance of those 17 KPIs. The evaluation has shown that most KPIs are determined as essential but difficult to measure. In addition, most KPIs require a notable amount of time for performance requirements to be met; hence, stakeholders should try to make them achievable at a faster pace. Finally, the basic activities of ASM in Nigeria were evaluated to identify the risks and perform the risk analysis. The assessment reveals at least four risks that must be given special priority, including the fatalities/injuries, justified number of abandoned mines/pits, uncontrolled child labour, and inaccessibility to finance. This study involves a methodological approach that could be adjusted or used as is by the UN or the government of Nigeria, while it can be adjusted and implemented accordingly to the context of other African nations.

INTRODUCTION

Artisanal and small-scale mining (ASM) low-tech, labour-intensive mineral processing and extractionⁱ constitutes an essential livelihood for more than 40 million people living in rural and typically impoverished areas in lower-income countries across the developing world.ⁱⁱ As would be expected, the sector extracts minerals using generally rudimentary techniques that often lack mechanisation. It often occurs in a climate of informality, to varying degrees. There is also generally a lack of government support, environmental management, and planning occurring across a different form of formality, often leading to a range of environmental, socio-economic, and technical problems that affect the ecosystems, communities, and miners.

In addition, the informality of the sector often contributes to deficits in operational health and safety, causing potential health impacts to those involved.ⁱⁱⁱ Nigeria is located in the western part of sub-Saharan Africa, and has an active ASM sector, being richly endowed with a total of 43 solid mineral productions.^{iv} Ironically, only 0.18% of mining in 2018 contributes to the national economy when compared to the mining sector of South Africa, Botswana, and Ghana (7.3%, 12.6%, and 16%) respectively.^v Several attempts have been made to revitalise the poor mining sector of the country through the government and World Bank from 2005-2022.⁵ These include:

- Financial support from the World Bank
- Reducing mercury exposure, lead, and other harmful chemical substances
- Combating illegal mining through increased security and community engagement
- Presidential support for mining sector development (PAGMI).

Despite those actions and the development of KPIs from the World Bank, it yielded unsatisfactory results.^{vi} Some of the problems of the stakeholders include time management and financial factors.^{vii} Thus, what are the most effective KPIs strategies for improving the ASM sector in Nigeria? Performance management tools such as SMART have already been adopted by many business companies around the world to boost their performance and improve outcomes.

Method

The methodology implemented in this work is the combination and adjusting of the general existing KPIs in Nigeria,⁷ and the challenges of ASM in Nigeria.⁴ Since it is not clear how effective the KPIs of the World Bank especially without taking into account the specific conditions in Nigeria. In addition, there is no clear distinction between the performance of ASM and large-scale mining (LSM). Therefore, the survey data that was released from 2017 to November 2021 by the World Bank was applied to evaluate the existing KPIs to identify and propose more KPIs that were not in the existing KPIs. A new set of 17 KPIs was developed with their related SDGs.

Table 1. Proposed KPIs that require to be addressed in the ASM sector in Nigeria

<i>Specified KPIs</i>	<i>Related SDGs</i>
Decreasing the number of abandoned mines/pits	3, 6, 13 and 15
Decreasing the number of mercury usage	3 and 6
Decreasing the number of ASM activities in forest areas	13 and 15
Decreasing women's discrimination/social marginalisation	5
Decreasing the percentage of child labour	SDGs target 8.7 & 16.2
Increasing the number of pipe-borne water systems in rural areas	3 and 6
Increasing the percentage of access to credit facilities	1 and 8
Decreasing the number of fatalities and injuries	3
Increasing the number of nearby health care facilities	3
Implementation of legislation of health & safety regulations	3
Increasing the training of artisans concerning health & safety	3
Strict implementation to curb smugglers	16
Reducing the cost of licensing fees, royalties, and tax	3 and 4
Implementation of decentralised mineral title	5, 6, 8, and 11
Implementation of more experts to sensitise ASM operators and miners on mining regulation and policy	3
Implementation of automation and digitisation in mining	8 and 12
Increasing urban infrastructure development projects	9

Summary of Results

One way to evaluate the relevance of the 17 identified KPIs is to use SMART criteria together with their relative weighting. The relative weighting is applied to know-how specific, measurable, attainable, relevant, time-bound, and how efficient those KPIs are, and also to determine the possible risk that could have a major impact. It revealed that most of the KPIs have high values and are determined to be

significant and there is only a small difference in priority among them. A risk analysis is performed to identify and justify more priorities that are most important (Table 2).

Table 2. Identified ASM risks and risk analysis

Risk Type	Identified ASM risks in Nigeria	Probability	Impact	Risk	Risk colour
Environmental	Justified number of abandoned mines/pits	4	5	20	Red
	Proliferation of mercury use	4	3	12	Orange
	Environment prone to flooding	2	4	8	Yellow
Social	ASM activities in the forest areas	2	4	8	Yellow
	Continual social discrimination/marginalisation of women	3	3	9	Yellow
Economic	Uncontrolled number of child labour	4	4	16	Orange
	Yield risk	3	3	9	Yellow
Health & safety	Unregulated ASM mine planning	4	3	12	Orange
	Fatalities and injuries	4	5	20	Red
Governance	Diseases	3	4	12	Orange
	Inaccessibility to finance	4	3	12	Orange
	Problem of land ownership	4	3	12	Orange
	Policy	3	3	9	Yellow

Conclusions, limitations, and future work

- Policy must aim to assist stakeholders by bringing more experts into the sector to sensitise the miners, especially on the technicalities of mining in bringing down those risks.
- Policy must try to address more than one KPI, for instance increasing the number of health facilities will help the miners, but might not be enough if the government services do not follow them.
- In this work, there are limitations in the accuracy of data because there are no means of consulting the World Bank and the government of Nigeria. The identified KPIs in this study are difficult to measure because the quantifiable criteria to evaluate them is limited.
- There is an ongoing survey in Nigeria by the World Bank. This methodology is valid for the future; if more results come in, it will give a precise and accurate evaluation and this should be part of the methodology of other ASM countries.
- Adjusting the risk analysis to other countries will require a wide diversity of expert consultants.

ⁱ Hilson, G., 2009. Small-scale mining, poverty and economic development in sub-Saharan Africa: an overview. Resources Policy, 34 (1-2), 1-5.

ⁱⁱ World Bank. 2019. 2019 State of Artisanal Mining and Small-scale Mining Sector. Washington, D.C: World Bank.

ⁱⁱⁱ Laing, T., Moonsammy, S., 2020. Evaluating the impact of small-scale mining on the achievement of the sustainable development goals in Guyana.

^{iv} World Bank, 2017. The Mineral Sector Support Development Diversification Project (MinDiver) (P159761) Implementation Status and Results Reports.

^v Ango, M.; Erdenebat, B.; Tang, K.Y. Creation of a Sustainable Mining Program through Formalization of Artisanal and Small-Scale Miners; Columbia University Press: New York, NY, USA, 2019.

^{vi} Oramah, I.T., Richards, J.P., Summers, R., Theresa, G., McGee, T., 2015. Artisanal and small-scale mining in Nigeria: Experiences from Niger, Nasarawa and Plateau states.

^{vii} World Bank, 2012. Implementation Completion and Results Report (Ida-40120) on a Credit in the amount of SDR 80.1 million (US\$120 Million Equivalent) to the Federal Republic of Nigeria for a Sustainable Management of Mineral Resources Project. Report No: ICR2258.



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