ECONOMICS AND ENVIRONMENTAL-HEALTH RISK ASSESSMENT FOR SUSTAINABLE DEVELOPMENT OF THE GOLD MINING INDUSTRY IN NIGERIA

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Abstract: Though the gold mining industry potentially generates employment and increases Nigeria’s foreign exchange, the crude practices of artisanal miners often exacerbate environmental degradation and health hazards. Hence, humans face health risks when excessively exposed to the heavy metals released during gold mineralization. This study, therefore, adopts a descriptive approach towards suggesting a comprehensive economic evaluation and risk analysis for managing the impact of gold mining industry sustainably and bearing in mind people’s health that should equally be managed in a healthy and sustainable manner. A review of existing Environment-Health Risk Assessment (EHRA) studies on gold mining areas in Nigeria reveals that the estimated risk quotients are generally above recommended limits consequent upon inadequate enforcement of mining precautions. This study, therefore, argues that incorporating EHRA studies and considering economic costs and benefits of mining could provide an objective benchmark for managing various estimated health risk quotients and returns from more gold mining. For Nigeria’s, harnessing opportunities in the gold mining industry requires interdisciplinary drive that seeks to incorporate environmental-health risks into optimization of gold mining industry. Appropriate policy interventions will be expedient for gold mining industry to be less harmful and not constitute direct threat to sustainable development in Nigeria.

Keywords: sustainable development, health risk assessment, gold mining, Nigeria.

1. INTRODUCTION

Throughout history, gold has held a position of value. The precious metal determined the value of currencies during the gold standard system, and it is still in high demand due to its ostentatious value. For resource-rich nations, the gold mining industry could be very important. In addition to the potential revenues the industry yields, countries endowed with gold could benefit as the precious metal is considered a safe haven asset and provides a hedge against global uncertainties as was seen during the COVID-19 pandemic (KPMG, 2021). The gold mining industry, therefore, could contribute to Nigeria’s development.
Although Nigeria has not fully harnessed the inherent opportunities in gold mining due to desertion of mines by colonial mining firms, inadequate funding, poor infrastructure and dependence on crude oil (Van Vuuren, 2019), the increased exploitation of gold raises concerns that gold deposits could be extracted sub-optimally or even exhausted, and that gold mining activities negatively impact on the environment. In the last few years, the government has been making attempts to regulate the industry, especially because of its revenue potential. However, regulations and policy considerations have not sufficiently incorporated assessments of the health impacts of the environmental degradation resulting from gold mining (Oke et al., 2020).

Human activities often leave the environment at a loss, and gold mining is a salient case study. Across gold-endowed nations, and especially in Nigeria, studies highlight that gold mining significantly contributes to the contamination of the soil, water bodies, plants and rocks with heavy metals such as copper, zinc, arsenic, cadmium, mercury and lead (Eludoyin, et al., 2017; Tun et al., 2020; Adewumi, & Laniyan, 2021). People are, therefore, predisposed to health hazards when they are overly exposed to these heavy metals, especially when the elements are ingested or inhaled above certain limits (Adewumi, et al., 2020).

In a bid to achieve sustainable development of the Nigerian gold mining industry, a comprehensive assessment approach is needed. While economic and value-creating prospects exist, environment-health risks must also be checked. In itself, sustainable development encompasses the economic, environmental and social dimensions of sustainability as well as the key elements underpinning sustainable development: people, planet, prosperity, peace and partnership (United Nations, 2015). Several studies have, therefore, made attempts to consider the across-the-board impacts which gold mining exerts, quantifying the health risks traceable to the resulting environmental degradation. While the increasing regulations of activities impacting the environment have seen economic analyses on environmental health policy increase over the years, Phelan (1998) argued for more economic perspectives to influence these policy directions. Hence, this paper highlights that economics is vital in the assessment of the Nigerian gold mining industry, and provides insights into accounting for the negative externalities on the health of people living around artisanal/subsistence mining settlements and policy responses to mitigate the hazards induced by gold mining in Nigeria.

2. LITERATURE REVIEW

Economics is widely recognised because of its applicability to a diverse range of issues and phenomena. Since humans are constantly faced with multifaceted and complex problems, collaborative and interdisciplinary research to resolve these issues has been on the increase. Economics has been pivotal to many of these studies; finding expression in issues bordering on health, education, energy, law, governance, and physics among others. Thus, sufficient grounds for assessing the gold mining industry’s drive towards sustainable development through the “economics lens” exist.

Economists see risk reduction as producing utility or satisfaction to people, and these benefits are captured by the willingness of people to pay to get the accompanying satisfaction from reduced hazards. While risk assessment methods could help in quantifying risk, economics goes further by trying to evaluate the benefits of risk reduction in monetary terms (Dockins et al., 2004). For instance, the revealed preference approach and the stated preference approach among other developments in the economics literature have been adopted to estimate the values individuals place on lower likelihoods of experiencing health hazards from environmental contamination (Lichtenberg, 2010).

Economics also plays a significant role in quantifying the costs of environmental health policies. The concept of opportunity cost stands out for economists, and it is often used in
estimating the cost of interventions since it provides a more realistic outlook of what was lost as a result of the policy action. From the perspective of reducing health and environmental hazards due to gold mining, economics asks the question “At what cost was this risk reduction achieved?” After denominiting both costs and benefits in the same unit, evaluating the trade-offs then becomes possible and an informed decision between alternative lines of action can be made. This is the economics angle, and as Hammitt and Robinson (2021) put it, it is the “essence of decision analysis” (p. 559).

The growing concern about environmental sustainability as well as the potential consequences of environmental degradation on life of the people have also stimulated efforts in quantifying risk. Contributions to the literature have bordered around health risk assessment, ecological risk assessment and comparative risk assessment. Since the pioneering efforts of the United States Environmental Protection Agency (EPA) in the 1970s, several environment-health risk assessment (EHRA) frameworks and EPA’s projects have been deployed across countries. The frameworks are meant to understand how human activities influence the environment, characterise the health effects of environmental factors and pollutants, and identify and assess policies available for curbing toxic substances. (Cristofaro & Jones, 1988). Specifically, EHRA is defined as “the process of estimating the potential impact of a chemical, physical, microbiological or psychosocial hazard on a specified human population or ecological system under a specific set of conditions and for a certain time frame” (Department of Health and Aged Care, 2012, p. 3). It yields a perception of the potential benefits of policies aimed at reducing health risks from exposure to toxic substances. When properly conducted, environment-health risk assessments wield quality evidence which is often useful in directing environmental health policies. Particularly, EHRA often requires field surveys due to the context-specific behaviours and responses of different populations to different pollutants (Urban Sanitation Development Program, 2014). While EHRA provides estimates of exposure to risk, policymakers still have to make a decision on what level of risk that can be tolerated.

Since its conceptualisation in the 1987 report by the World Commission on Environment and Development, sustainable development has been widely appreciated and pursued across nations. As defined in the report, sustainable development is the “development that meets the needs of the present without compromising the ability of future generations to meet their own needs” (WCED, 1987, p.54). Furthermore, the principles of sustainable development embrace economic development, environmental sustainability and social well-being. Thus, for a nation or an industry to develop on a sustainable path these three dimensions of sustainability must be ensured.

Among the key elements of sustainable development is “people” (United Nations, 2015). There is no sustainable development if the basic needs of people in the present generation and those unborn are unmet. Some of the sustainable development goals (SDGs) are aimed at ending poverty and hunger and promoting good health and well-being, and this resonates with people. Along with the concerns for the environment and planet, the health of people is at the heart of sustainable development. More so, the environment places demands on the health of people living within it. Hence, efforts towards achieving sustainable development can be considerably measured from an assessment of the environmental-health implications of such interventions.

The gold mining industry is not inconsequential, at least for two reasons. Firstly, the employment and revenue generation drive for the economy of Nigeria. Secondly, the potential environmental and health consequences from its unregulated and improper extraction and processing. Thus, concerns are often raised about the unsustainable extraction of non-renewable natural resources such as gold to the detriment of future generations (Hotelling, 1931). The gold mining industry can, therefore, promote or obviate sustainable development in Nigeria.
While a significant number of environment-health hazard assessment studies of gold mining in Nigeria suggest a negative outlook on indices that are essential for sustainable development, some studies have downplayed the risks, especially when the mining is done observing adequate precautions. Notably, artisanal mining could cause water pollution, derailing Nigeria’s progress towards achieving SDG 6: Clean Water and Sanitation, and SDG 14: Life Below Water. In addition, studies have found evidence of soil degradation in active and abandoned gold mining areas, hurting farmlands, causing stunted growth in plants, and threatening food security (Eludoyin et al., 2017; Bello, 2022). This impinges on SDG 2: Zero Hunger, while also worsening SDG 3: Good Health and Well-Being and SDG 15: Life on Land.

On the other hand, the Nigerian government could generate considerable foreign exchange and tax revenue from promoting activities and attracting investments into the gold mining industry. The previous administration in Nigeria implemented regulations and development which was hoped to create 250,000 jobs while generating $500 million from royalties and taxes of gold trade (Reuters, 2020). If achieved, this could spur the nation towards achieving SDG 8: Decent Work and Economic Growth, and SDG 1: No Poverty, while the revenue could be used to strengthen infrastructure and invest in human capital. The gold mining industry, thus, needs to be properly monitored, ensuring that the environmental impacts of mining are managed, with the remediation of affected areas while investing the gains from the sector to improve other dimensions of sustainable development.

On the conduct of assessments for sustainable development, arguments have ensued in the economics literature. While earlier studies made use of data from conventional national accounting, the neglect of the environment in such calculations motivated developments including the integration of the adverse health effects of environmental quality degradation with economic accounting by Bartelmus, et al., (1991). Indices like the World Bank adjusted net savings which accounts for environmental degradation have also been used, bearing strong evidence that the economics lens are not self-sufficient and that health and environmental concerns have to be taken into consideration (Koirala & Pradhan, 2020; Oyeranti & Obijole, 2023).

Economics-environment-health risk assessment (EEHRA) harnesses the strengths of both approaches. Environmental experts and toxicologists can effectively deploy their scientific risk assessment tools for dose-response estimation and exposure assessment. On the other hand, economics deploys tools in valuing environmental benefits, establishing probabilities and discounting based on the preferences of the affected individuals (National Environmental Health Partnership Council, 2016). A cost-benefit analysis tracks streams of costs and benefits over time, and since the utility people derive from future risk reduction is less than the utility from immediate risk reduction; it is important to factor in the time value of risk reductions. In addition, environmental problems involve uncertainties, behavioural changes, sunk costs and sunk benefits – issues that the concept of opportunity cost and developments in behavioural economics could help capture (Phelan, 1998; Johnson & Slovic, 1998).

3. METHODOLOGY: CONTENT ANALYSIS APPROACH

3.1. Profile of the Gold Mining Industry in Nigeria

Along with vast amounts of crude oil and natural gas reserves, Nigeria is endowed with solid minerals including gold, iron ore, coal and bitumen. Nigeria’s gold deposits are mostly found in the present-day northwestern and southwestern regions of the country notably Maru, Anka, Malele; Tsofion Birinin Gwari and Kwaga, Bin Yauri, Gurmana, Okolom-Dogondaji, Iperindo (Kankara & Darma, 2016). Although, the global oil price shock of the 1970s saw
increased attention on crude oil extraction, the mining and trade of solid minerals had begun many decades before – during the colonial period. From 1914, gold mining began in Northern Nigeria, and in the 1940s, alluvial mining began in Western Nigeria. While production of gold increased with the discovery of new mines, mining has not been sustained over time as most of the miners operated on a small scale (Falola, 1992; Van Vureen, 2019).

Gold mining in Nigeria has also been fraught with issues around illicit mining, smuggling and environmental degradation. Since mining could be done using the hands, it provided an incentive for people to mine gold illegally and sell it to goldsmiths, destroying several acres of arable farmlands in the process (Falola, 1992). In addition, the government lost royalties as much of the gold mined was not declared and illegal markets for gold thrived especially with the high demand for gold in Western Nigeria. The government, therefore, adopted several ordinances and regulatory policies on gold traders and miners.

In more recent years, there has been rekindled interest in developing the gold mining industry to achieve economic diversification, generate more revenue for the government and curb illegal mining (Reuters, 2020). While 1.51 tonnes of gold was produced in 2020, it is estimated that Nigeria still has 600,000 tonnes of untapped alluvial and primary gold deposits (Oxford Business Group, 2023). With large-scale investments and improved regulatory oversights, the potentials are realisable as non-crude oil mining activities only accounted for a meagre 0.6% of the GDP in 2021 (Central Bank of Nigeria, 2022). Since the launch of the Presidential Artisanal Gold Mining Development Initiative (PAGMDI) in 2019, one large-scale mining operator has been attracted, two gold refineries have been licensed, and developments have been made towards creating gold buying centres and taxing gold trade (KPMG, 2021; Reuters, 2020). It is hoped that these developments can have positive trickle-down effects on the Nigerian economy.

4. FINDINGS AND DISCUSSION

4.1. Gold Mining Industry-Induced Environment-Health Hazards in Nigeria

Since gold has been relatively expensive and coupled with the high demand for gold in the southwest, the discovery of gold in Ilesha triggered the “gold rush” in the 1940s (Falola, 1992). Many people began illicit artisanal gold mining to earn income for their households, contaminating the environment with toxic heavy metals in the process. This destruction of the environment negatively impacts the health of the miners and people living within the neighbourhood. More so, unregulated artisanal mining in Nigeria increases the severity of the risks involved as gold ores are often extracted, handled, stored and transported without precautions (Oke et al., 2020).

Heavy metals associated with gold mining in Nigeria include arsenic, cadmium, nickel, lead, copper, zinc, cobalt and mercury (Adewumi et al., 2020). Meanwhile, these toxins build up in plants and animals and can damage the brain, kidney, liver, and bone marrow as well as increase the likelihood of blood and respiratory infections in humans when ingested through food in excessive amounts. For example, several cases of childhood lead poisoning traceable to gold ore processing were confirmed across villages in Zamfara State between May and September 2010. Lo et al. (2012) investigated the health effects of lead poisoning over the period and found that, in ore-processing villages, there were more infected children under the age of 5 years in addition to significantly higher risks of death from convulsion. A scientific study on the Anka gold mining area of Zamfara also confirmed a significant accumulation of heavy metals in the nails and hairs of children due to lead poisoning (Adewumi et al., 2020).
Beyond lead poisoning, studies have also confirmed that gold mineralisation has polluted water bodies, significantly increasing the risk of exposure to arsenic and mercury (Lo et al., 2012; Adewumi & Laniyan, 2021; Nurfadillah & Maksum, 2021). Nonetheless, a few studies have argued that artisanal gold mining in Nigeria does not pose considerable environmental radiation risks and, hence, has little threat to human health (Adebayo et al. 2022). Indeed, Garba et al., (2021) confirmed in their study across areas in Zamfara by comparing the terrestrial radiation dose measurements with the world average, that illegal mining did not exacerbate the health risks. Similarly, Adebayo et al. (2022) found moderate health risk quotients from exposure to elements from the Ife-Ijesha gold mining area in southwestern Nigeria.

Through a number of studies on likelihood of environment-health risks, different guidelines for environment-health risk assessment have been generated. For instance, Lo et al. (2012) conducted dose-response and exposure assessments and classified the soil-lead exposure levels in affected communities of Zamfara using the US EPA recommendations. It was on the basis of EHRA that their study confirmed the higher risks to children in settlements along gold mining areas. The human health risk assessment conducted by Oke et al. (2020) found that the concentration of chromium was beyond safe levels in the Epe gold mining area and contributed to increased cancer risks for people with prolonged exposure. Taiwo & Awomeso (2017) found same for Ijeshaland gold mining areas. Bello et al. (2022) also arrived at the same conclusion that cancer burdens were higher for onsite dwellers in gold mining areas after comparing risk estimates derived using RESRAD meaning RESidual RADiation and ERICA that is a software system that with a structure based upon the tiered ERICA Integrated Approach to assess the radiological risk to terrestrial, freshwater and marine biota (assessment computer programs with the US EPA acceptable limits).

4.2. Management of Gold Mining-Induced Environment-Hazards in Nigeria

Environment-health risk assessment (EHRA) guidelines are often engaged in analysing the likelihood that humans experience health hazards due to environmental degradation occasioned by activities such as gold mining. EHRA studies are often conducted by pure scientists including toxicologists, geologists, geochemists, and environmental and public health experts. Their findings and risk quotients are, thus, often expressed in scientific notations. While it is essential to base policies on scientific and rigorous evidence as provided in such studies, incorporating economic evaluations of the cost and benefit of proposed risk reduction policies will help in deciding on optimal policies to pursue. Importantly, economics plays a vital role in providing monetary valuations of risk reduction policies (Dockins et al., 2004). A National Environmental Health Partnership Council (2016) report, for instance, that every $1 invested in national and state-level health programmes yielded $71 in asthma-related cost savings. This finding was arrived at from economic evaluation studies, providing a benchmark for weighing the loss from environmental damage to realisable gains.

Though outside the context of gold mining, a health economic evaluation of atrial fibrillation screening in mitigating cardiovascular diseases in Nigeria by Jacobs et al., (2021). Using Quality of Life Adjusted Years (QALY) and comparing with the cost of atrial fibrillation screening, this study showed that screening was cost-effective in reducing health burdens. Mulder et al. (2022) also compared the monetary values of the benefits and costs of using a new drug in treating drug-resistant tuberculosis across Nigeria, Indonesia and Kyrgyzstan. In Mexico, Evans et al., (2021) adopted this interdisciplinary approach to quantifying the mortality benefits and costs of implementing diesel retrofits to improve air quality.
5. RECOMMENDATIONS AND CONCLUSION

As the Nigerian government seeks to generate more revenue from regulating gold mining activities, economic management can be deployed to identify and evaluate policies that will yield better welfare outcomes and engender sustainable development. The findings can also guide in crafting an appropriate pollution tax which simultaneously curbs environmental degradation. As externalities are well studied in economics, efficient market-based mechanisms could be implemented to prevent overproduction and promote environmentally and socially friendly practices. Economic assessments in the Nigerian context could, therefore, help in mitigating the risks emanating from gold mining. Policies could be highly potent in influencing the needed and required changes in systems that will be sustainable development compliant for Nigerian gold mining industry.

First, regulations of artisanal and small-scale gold miners and traders should be strengthened. Beyond licensing gold miners and ensuring tax compliance, safety standards should be prioritised while on the gold mines as well as offsite: from the extraction stage to the mineralisation and processing of the gold ore, and to waste management procedures. Since small-scale artisanal gold miners are prone to breaching safety measures to cut operation costs, stringent monitoring should be done by regulatory agencies as well as proper communication and education on the environment-health risk.

Secondly, while the regulation of gold mining companies increases, the firms should also be encouraged to produce sustainability reports documenting their efforts in promoting sustainable development. As extractive firms often impact the environment negatively, efforts to mitigate the harmful impacts and promote sustainable development are beneficial. Mining companies could adopt newer technologies to reduce and properly manage the toxic wastes generated during their operations. As being practised by crude oil firms, gold mining firms should be urged to promote the development of their local communities through environmental remediation efforts and contribute to investments in human capital, especially health care and education. Several other policy measures could also be deployed to reduce the resulting environmental damage including retrofitting plant and equipment with environmentally friendly technologies, designing pollution permits, and levying pollution taxes on gold mining companies.

The gold mining industry could be a “gold mine” in spurring Nigeria’s progress towards sustainable development as the government seeks to generate foreign exchange, tax revenue and employment from scaling up investment in the sector and regulating artisanal mining. It could, nonetheless, constitute a drag on sustainable development due to the accompanying environmental degradation and health hazards resulting from excessive exposure to the heavy metals released during gold mineralisation. In Nigeria, water bodies and soils are often polluted with heavy metals including arsenic, cadmium, nickel, lead, copper, zinc, cobalt and mercury, resulting in cognitive disorders and other morbidities. As such, environment-health risk assessment (EHRA) guidelines have to be followed as best practice to quantify the health risks posed by elements with adverse health effects.

While several EHRA studies have been conducted on the health hazards around gold mining areas in northwest and southwest Nigeria, the risk reduction quotients reported in these scientific studies are often difficult to comprehend by non-technical audiences and policymakers. Expressing risk reduction benefits in monetary terms, using economic evaluation and cost-benefit analysis based on EHRA studies, will undoubtedly guide policies aimed at promoting the sustainable development of the Nigerian gold mining industry. This paper, therefore, calls for more research on economic evaluation and risk analysis of policies that could
harness the potential of Nigeria’s gold mining industry with little and insignificant environment-health risks.

REFERENCES


