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THE ANATOMY OF ARTISANAL GOLD MINING IN WESTERN KENYA

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Abstract:
This study examined the anatomy of artisanal gold mining in western Kenya. The specific objectives of the study were; to evaluate the effect of artisanal gold mining on land, water and air pollution in western Kenya, to evaluate the effect of artisanal gold mining on education in western Kenya, to evaluate the effect of artisanal gold mining on economic development in western Kenya, to evaluate the effect of artisanal gold mining on health and safety issues in Western Kenya and; to evaluate the effect of government regulation on artisanal gold mining in Western Kenya. The study was conducted in the western Kenya counties where artisanal gold mining is practiced. The target population consisted of 300 participants of artisanal gold mining. Data was collected using self-administered questionnaires. The collected data were subjected to inferential statistics using SPSS v. 26. Regression analysis was used. Linear regression analysis was conducted to establish the relationship between the study variables. The study results indicated that artisanal gold mining increases land, water and air pollution in Western Kenya. Further, the results indicated that artisanal gold mining increases economic growth in western Kenya, hence empowering the local community. On the other hand, the study results indicated that artisanal gold mining increases school dropouts in western Kenya, thereby affecting the area's educational prowess. Moreover, the results indicated that artisanal gold mining reduces the ability of gold miners and the community to take health and safety precautions in western Kenya, leading to high accident rates during mining. Finally, the results showed that government regulation helps regulate artisanal gold mining, thereby reducing pollution, school dropouts, and improving health and safety.

JEL: G30, M42, H83, D73

Keywords: artisanal gold mining, land, water and air pollution, education, economic development, healthy safety and government regulation

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1. Introduction

The artisanal gold mining industry has expanded quickly in low- and middle-income countries due to the rising value of gold and the challenges of making a living from agriculture and other rural income-generating activities (Ondayo, *et al*., 2023). Artisanal gold mining in Kenya constitutes a substantial yet frequently underdeveloped segment of the national economy (Yego, Kebenei, Cheserek, & Sitienei, 2018). Artisanal miners, typically operating in tiny, informal collectives, play a significant role in gold extraction across several regions of the country, particularly in Kakamega, Migori, Vihiga, and Narok. Artisanal mining is essential for sustaining livelihoods; nonetheless, it presents issues related to environmental impact, safety, and regulation (Odumo, *et al*., 2018).

According to Yego, Kebenei, Cheserek, and Sitienei (2018) artisanal gold mining refers to the employment of basic techniques to extract precious minerals from primary and secondary ore deposits, distinguished by the absence of long-term mining strategies. It may be either illegal or legal, formal or informal, ranging from individual gold planners to medium-scale enterprises employing thousands of individuals (Tampushi, Onyari, & Muthama, 2022). Artisanal gold mining denotes small-scale, frequently informal mining endeavors that employ basic tools and techniques to extract gold from mineral deposits. In Kenya, it is estimated that more than 500,000 individuals participate in this activity, either directly or indirectly. These miners generally utilize primitive implements such as picks, shovels, and pans to extract gold-bearing rocks (Buyela, *et al*., 2022).

Artisanal gold mining encompasses both legal and illegal operators, including mechanized and semi-mechanized miners of diverse scales regarding output, employment, and capitalization. These are classified into four categories: mines operated by experienced individuals, those managed by unsophisticated groups, registered gold panners, and cooperative miners (Ogola, Mitullah, & Omulo, 2002). Artisanal gold mining encompasses a wide range of operations primarily defined by the extraction of marginal or minor gold deposits, insufficient capital, labor-intensive methods, and limited access to markets and support services. The operations and organization of activities in artisanal mining negatively impact its productivity, capability, and adherence to mining, safety, and environmental rules, posing risks to both mining communities and their surroundings (Mitchell, Palumbo-Roe, & Bide, 2020).

Artisanal gold mining in Kenya, although it sustains several lives, has considerable environmental repercussions, especially concerning water, land, and air pollution. The unregulated and primitive techniques employed by small-scale miners frequently intensify these environmental effects. Artisanal gold miners often employ hazardous substances like mercury and cyanide to extract gold from ore. These toxins permeate into adjacent water sources, polluting rivers, lakes, and streams. Mercury is a hazardous contaminant that bioaccumulates in the food chain, impacting both aquatic organisms and human health (Buyela, *et al*., 2022). In Kenya, areas such as Migori, Kakamega, and Vihiga, where artisanal gold mining is prevalent, experience considerable water pollution. Water utilized in the gold extraction process is frequently discharged into the environment, contaminated with mercury, cyanide, and other

hazardous compounds. This adversely impacts local communities dependent on these water supplies for drinking and agriculture, while also harming aquatic ecosystems, resulting in the death of fish and other wildlife (Mlewa, Ondiaka, Alunda, & Kinyua, 2023).

Land degradation is a notable concern associated with artisanal gold mining in Kenya. The excavation of soil and mining operations result in extensive areas of disrupted land. These regions, frequently left rehabilitated, become susceptible to erosion, and the loss of vegetation exacerbates soil erosion, diminishing land productivity (Odumo, *et al*., 2018). In areas such as Narok and Migori, mining operations deplete the land's natural resources, resulting in diminished biodiversity and decreased agricultural viability. Heap leaching, a method utilizing cyanide or other chemicals to extract gold from ore, presents significant environmental hazards. If inadequately confined, the chemicals may infiltrate the soil, resulting in prolonged contamination. This can impair the land's capacity to sustain agriculture and lead to diminished soil fertility (Yego, Kebenei, Cheserek, & Sitienei, 2018).

Air pollution resulting from artisanal gold mining, although less frequently emphasized than water and land contamination, remains a considerable concern. The combustion of mercury to extract gold generates hazardous mercury fumes, which are inhaled by miners and nearby people. Exposure to mercury is associated with several severe health complications, including neurological impairment, renal failure, and developmental disorders in children. Furthermore, the utilization of firewood and charcoal for heating gold during extraction and smelting processes exacerbates deforestation and air pollution. The combustion of biomass for energy generates particulate matter and carbon emissions, hence worsening air quality problems in mining regions (Tampushi, Onyari, & Muthama, 2022).

Artisanal gold mining induces environmental contamination that presents both direct and indirect health hazards. Contaminated water sources can result in waterborne illnesses, whereas exposure to mercury and cyanide leads to significant health complications. Miners and adjacent communities face increased danger due to insufficient protective measures and a lack of information regarding safe mining procedures (Buyela, *et al*., 2022).

Artisanal gold mining in Kenya significantly contributes to local economies by offering work and income to thousands, especially in rural regions. It sustains the livelihoods of small-scale miners, their families, and other enterprises. Nonetheless, the sector encounters obstacles like inadequate working conditions, environmental deterioration, and restricted market access. Although it fosters economic progress, increased formalization and regulation are essential to guarantee sustainable development and optimize its economic potential (Yu, Wang, & Umair, 2024).

Artisanal gold mining in Kenya frequently affects education by redirecting children's focus from schooling to mining endeavors, particularly in communities reliant on it for revenue. Although mining can offer financial assistance to families, it may also result in child labor, diminishing school attendance and restricting educational prospects. Nevertheless, several mining areas have utilized revenue from gold mining to enhance

local educational institutions, while the overall impact on education is inconsistent (Mitchell, Palumbo-Roe, & Bide, 2020). Therefore, this study evaluates the effects of artisanal gold mining on pollution, education, the economy, and health.

1.1 Objectives of the Study

1) To evaluate the effect of artisanal gold mining on land, water and air pollution in western Kenya.
2) To evaluate the effect of artisanal gold mining on education in western Kenya.
3) To evaluate the effect of artisanal gold mining on economic development in western Kenya.
4) To evaluate the effect of artisanal gold mining on health and safety issues in Western Kenya.
5) To evaluate the effect of government regulation on artisanal gold mining in Western Kenya.

1.2 Research Hypothesis

1) Artisanal gold mining has no significant effect on land, water and air pollution in western Kenya.
2) Artisanal gold mining has no significant effect on education in western Kenya.
3) Artisanal gold mining has no significant effect on economic development in western Kenya.
4) Artisanal gold mining has no significant effect on health and safety issues in Western Kenya.
5) Government regulation has no significant effect on artisanal gold mining in Western Kenya.

1.3 Conceptual Framework

A conceptual framework is an assemblage of ideas and theories that directs research or practice. It delineates essential concepts, their interconnections, and their role in elucidating or resolving a situation. The following conceptual framework will guide the study.

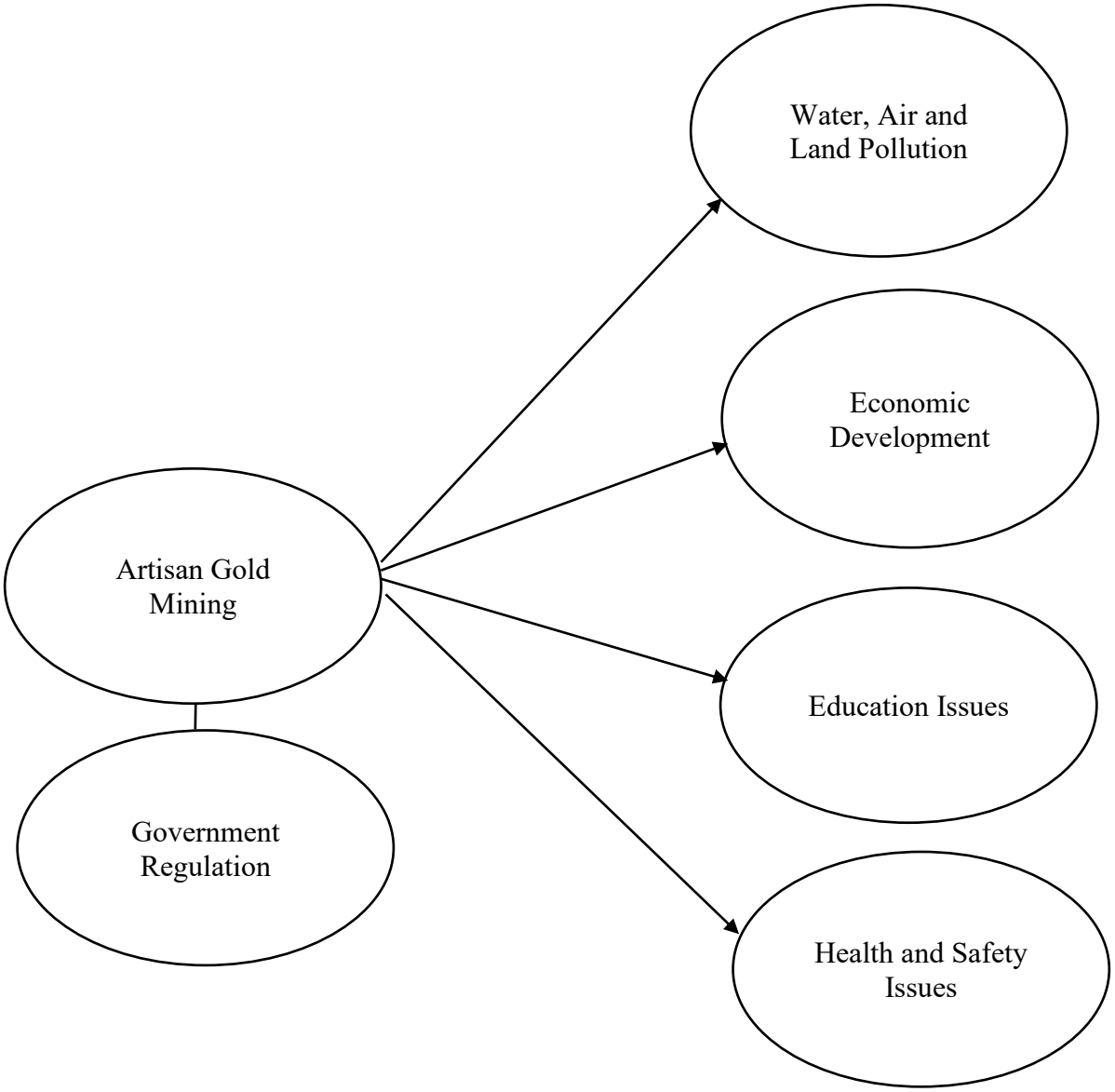

Figure 1: Conceptual Framework

2. Research Methodology

2.1 Study Area

The study was conducted in the western Kenya counties where artisanal gold mining was practiced. The counties included Vihiga County, Kakamega County, Siaya County, Migori County and Narok County.

2.2 Target Population

The target population consisted of 300 participants of artisanal gold mining: 50 gold miners, 50 laborers, 50 traders, 100 people from the local community, and 50 individuals from government regulatory bodies.

2.3 Data Collection Instruments

Data was collected using self-administered questionnaires. The researcher administered the research questionnaire. This allowed the researcher to establish rapport with the respondents and explain the purpose of the study and the meaning of the questions, which may not be apparent to the respondents. The questionnaires were designed to have closed questions. The closed-ended questions were easy to compute and analyze.

2.4 Data Analysis and Presentation

Data collected was subjected to inferential statistics using SPSS v. 26. Inferential statistics were done through regression analysis. Linear regression analysis was conducted to establish the relationship between the study variables.

$$Y = \beta_0 + \beta_1 AG + \varepsilon_0$$

Where,
Y is either Land, Water & Air Pollution, Economic Growth, Education, and Health & Safety Issues,
AG is Artisanal Gold Mining,
$\beta 0$ is Constant when there is no moderating variable.

3. Discussion of Findings

3.1 The Effect of Artisanal Gold Mining on Land, Water and Air Pollution in Western Kenya

$$Y = 0.072 + 0.671AG \quad (1)$$

The first objective of the study was to evaluate the effect artisanal gold mining on land, water and air pollution. The study findings had a constant of 0.072 which implied that in absence of artisanal gold mining there is minimal land, water and air pollution in western Kenya. This result implies that when there is no artisanal gold mining there is 7.2% of land, water and air pollution. The study also found out that artisanal gold mining has a positive effect on land, water and air pollution. This implies that an increase in artisanal gold mining increases land, water and air pollution by 67.1%. This result indicates that artisanal gold mining increases land, water and air pollution in Western Kenya.

3.2 The Effect of Artisanal Gold Mining on Economic Growth in Western Kenya

$$Y = 0.342 + 0.842AG \quad (2)$$

The second objective of the study was to evaluate the effect artisanal gold mining on economic growth in western Kenya. The study findings had a constant of 0.342, which implied that in the absence of artisanal gold mining, there is 34.2% economic growth in

western Kenya. The study also found out that artisanal gold mining has a positive effect on economic growth in western Kenya. This implies that increase in artisanal gold mining increases economic growth in western Kenya by 84.2%. This result indicates that artisanal gold mining increases economic growth in western Kenya hence empowering the local community.

3.3 The Effect of Artisanal Gold Mining on Education in Western Kenya

$$Y = 0.023 + 0.236AG \quad (3)$$

The third objective of the study was to evaluate the effect of artisanal gold mining on education in western Kenya. The study findings had a constant of 0.024 which implied that in absence of artisanal gold mining there is 2.4% rate of school dropouts in western Kenya. The study also found out that artisanal gold mining has a positive effect on education in terms of school dropouts in western Kenya. This implies that increase in artisanal gold mining increases school dropout cases in western Kenya by 23.6%. This result indicates that artisanal gold mining increases cases of school dropouts in western Kenya, hence affecting the educational prowess of the area.

3.4 The Effect of Artisanal Gold Mining on Health and Safety Issues in Western Kenya

$$Y = 0.721 - 0.146AG \quad (4)$$

The fourth objective of the study was to evaluate the effect artisanal gold mining on health and safety issues in western Kenya. The study findings had a constant of 0.721 which implied that in absence of artisanal gold mining there is 72.1% rate of health and safety precautions in western Kenya. The study also found out that artisanal gold mining has a negative effect on health and safety issues in terms of taking precautions in western Kenya. This implies that increase in artisanal gold mining decreases the ability of gold miners to take precaution in western Kenya by 14.6%. This result indicates that artisanal gold mining reduces the ability of gold miners and the community to take health and safety precautions in western Kenya, hence high cases of accidents during mining.

3.4 The Effect of Government Regulation Artisanal Gold Mining in Western Kenya

$$Y = 0.452 - 0.121GR \quad (5)$$

The fifth objective of the study was to evaluate the effect governmental regulation on artisanal gold mining in western Kenya. The study findings had a constant of 0.452, which implied that in the absence of governmental regulation, there is a high rate of artisanal gold mining, which stands at 45.2% in western Kenya. Increase in artisanal gold mining increases land, water and air pollution, leads to a high rate of school dropouts and leads to high cases of non-adherence to health and safety precautions. The study also

found that government regulation has a negative effect on artisanal gold mining in western Kenya. This implies that the implementation of governmental regulations decreases the rate of artisanal gold mining in western Kenya to 12.1%. This result indicates that government regulation helps in regulating artisanal gold mining, hence reducing cases of high pollution, school dropouts and improving health and safety issues.

4. Conclusions and Recommendations

4.1 Recommendations

The study found that artisanal gold mining significantly increases land, water, and air pollution in Western Kenya, with a 67.1% increase in pollution linked to mining activities. This indicates that artisanal mining negatively affects the environment. The report recommends the enactment of more stringent environmental protection regulations that restrict detrimental mining practices, including the utilization of hazardous chemicals (e.g., mercury) and inadequate waste management methods.

The study shows that artisanal gold mining positively impacts the economy of Western Kenya, contributing 84.2% to economic growth. This suggests that the local economy benefits from mining activities through income generation and employment. The study recommends that small-scale miners should be facilitated with access to capital, equipment, and training to improve productivity and optimize economic advantages. Promote the establishment of alternative industries in conjunction with mining to guarantee enduring, sustainable growth and diminish reliance on mining.

Artisanal gold mining increases school dropout rates by 23.6%. This suggests that children may be leaving school to participate in mining activities, affecting their education and long-term prospects. The study recommends the development of educational programs that specifically address the negative impacts of mining on education and encourage students to complete their schooling. The government should strengthen laws to prevent child labor in mining operations and ensure that children remain in school rather than participating in harmful mining activities.

The study revealed that artisanal gold mining negatively affects health and safety precautions, reducing the ability of miners to follow safety measures by 14.6%. This indicates a high risk of accidents and poor working conditions. The study recommends the provision of comprehensive health and safety training for miners, emphasizing the importance of protective gear and safe mining practices. Ensure that health and safety regulations are properly enforced within mining communities to reduce accidents and injuries.

Government regulation has a significant positive impact, reducing the rate of artisanal gold mining by 12.1%. Effective government intervention can reduce environmental and health impacts while ensuring fair practices. The report advocates for the implementation of more stringent laws governing artisanal gold mining, emphasizing environmental protection, safety, and the deterrence of unlawful mining activities. Collaborate intimately with artisanal miners to formulate policies that reconcile regulation with the economic advantages they offer. This encompasses providing

assistance for sector formalization, enhancing working conditions, and mitigating illegal mining activities. Consistently evaluate the efficacy of governmental laws and modify policy to tackle new difficulties in the artisanal gold mining industry.

4.2 Study Conclusion

In conclusion, the findings of this study reveal a complex relationship between artisanal gold mining and various socio-economic and environmental factors in Western Kenya. Artisanal gold mining significantly contributes to land, water, and air pollution, increasing pollution levels by 67.1%. This highlights the environmental cost of mining, which must be addressed through sustainable practices. Despite the environmental impact, the study also shows that artisanal gold mining positively contributes to economic growth, with an 84.2% increase in local economic activity, which empowers the local community through job creation and income generation.

However, there are negative consequences for education and health. The increased mining activities are linked to a 23.6% rise in school dropout rates, indicating that mining often draws children away from school. Furthermore, the study found that mining reduces adherence to health and safety protocols by 14.6%, increasing the risk of accidents and health issues among miners and the community.

Government regulation plays a crucial role in mitigating the negative effects of artisanal gold mining. Effective regulation has been shown to reduce the extent of mining activities by 12.1%, helping to curb pollution, reduce school dropouts, and improve safety standards. Therefore, while artisanal gold mining offers economic opportunities, it is essential that it is regulated to balance economic benefits with environmental sustainability, education, and health concerns**.**

Conflict of Interest Statement

The authors declare no conflicts of interest.

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