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The Paradox of Small-Scale Gold Mining and Sustainable Development: An Analysis of GRDP, Poverty, and Environmental Quality Index in West Lombok Regency

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ABSTRACT
Small-scale mining activities are one of the growing economic activities in West Lombok Regency and have the potential to contribute to the socio-economic conditions of the community. This study aims to analyze the relationship between the contribution of the mining sector to the Regional Domestic Product (RDP) and the poverty rate as well as the Environmental Quality Index (EQI). The study uses a quantitative approach with simple linear regression analysis of secondary data for the 2019-2023 period sourced from the Central Statistics Agency and the Ministry of Environment and Forestry. The results show that the contribution of the mining sector to GRDP is relatively small, ranging from 2.01% to 2.08% of the total regional economy. The analysis results show that the contribution of the mining sector has a strong relationship with the poverty rate with a coefficient of determination value of $R^2 = 0.8897$ (≈0.8), indicating that an increase in mining activity is associated with a decrease in the poverty rate. This condition is related to the involvement of local communities in mining activities as a source of livelihood. Meanwhile, the relationship between the contribution of the mining sector and the quality of the environment shows a relatively weak relationship with an R^2 value of 0.2108 (≈0.2). This indicates that changes in environmental quality are not only influenced by mining activities but also by various other environmental factors.

1. INTRODUCTION

The mining sector is one of the key drivers of regional economic development because it contributes to economic growth, job creation, and increased local economic activity (Hilson et al., 2020; Li Donni et al., 2021). In various regions of Indonesia that have mineral resource potential, mining activities often provide an alternative livelihood for the community (Allen & Porter, 2016). However, the development of this sector also often poses development dilemmas because, in addition to providing economic benefits, mining can have significant social and environmental impacts (A. Bebbington et al., 2018).

The province of West Nusa Tenggara (NTB) is one of the regions with potential mineral resources, including gold. In addition to industrial-scale mining, mining activities have also developed in the form of small-scale mining carried out traditionally by the community (Chimunhu et al., 2022; Zhou & Ge, 2021). One of the areas known as a center for small-scale gold mining on the island of Lombok is the Sekotong District in West Lombok Regency. Mining activities in this region began to grow rapidly after the discovery of gold deposits by local communities in the late 2000s, attracting many local workers to engage in mining activities (Meutia et al., 2022).

The existence of small-scale gold mining has an impact on the dynamics of the local economy, particularly through increased community income and the growth of informal economic activity around mining areas. However, these economic benefits are not always accompanied by an equitable improvement in community welfare (Leeuw & Mtegha, 2018). In some cases, areas with mineral resource potential still face relatively high levels of poverty (A. J. Bebbington et al., 2018; Damoah & Boglo, 2026). This shows that the utilization of natural resources is not always directly proportional to an increase in community welfare.

In addition to economic and social impacts, small-scale gold mining activities also have the potential to cause environmental pressure. Traditional gold mining and processing methods often use chemicals such as mercury, which can contaminate soil and water and endanger human health (Esdaile & Chalker, 2018; Keane et al., 2023). Poorly managed mining activities can also cause land degradation, changes in the landscape, and a decline in the quality of the environment around the Mining and Community Poverty Conditions mining area (Bruin et al., 2023).

Based on these issues, this study aims to analyze the relationship between the development of the mining sector and the socioeconomic and environmental conditions in West Lombok Regency. To avoid subjective interpretations, this study not only uses descriptive analysis but also applies statistical correlation analysis to examine the relationship between the mining sector's contribution to the Gross Regional Domestic Product (GRDP) and the poverty rate and the Environmental Quality Index (EQI). This approach is expected to provide a more objective picture of the role of the mining sector in regional development dynamics.

Based on the research questions and objectives, the hypotheses in this study are as follows:

H1 : There is a correlation between the mining sector's contribution to the gross regional domestic product and the poverty rate in West Lombok Regency.

H2 : There is a relationship between the contribution of the mining sector to GRDP and the Environmental Quality Index.

2. RESEARCH METHOD

This study uses a quantitative approach with descriptive methods to analyze the relationship between mining activities and economic, social, and environmental conditions in the study area. The study was conducted in Sekotong District, West Lombok Regency, West Nusa Tenggara Province, which is one of the areas with fairly developed small-scale gold mining activities.

In addition to descriptive analysis, this study also uses correlation analysis to determine the relationship between the mining sector and socioeconomic and environmental conditions. Correlation analysis is used to measure the relationship between the mining sector's contribution to the Gross Regional Domestic Product (GRDP) and the poverty rate and Environmental Quality Index (EQI) in West Lombok Regency. The data used is time series data obtained from the Central Statistics Agency and the Ministry of Environment and Forestry.

The relationship between variables was analyzed using Pearson's correlation coefficient with the following formula:

$$r = \frac{n\sum XY - (\sum X)(\sum Y)}{\sqrt{[n\sum X^2 - (\sum X)^2][n\sum Y^2 - (\sum Y)^2]}}$$

Description:

r = correlation coefficient
X = contribution of the mining sector to GRDP
Y = poverty rate or EQI value
n = number of observations

Correlation coefficient values range from -1 to +1. Positive values indicate a direct relationship, while negative values indicate an inverse relationship.

3. RESULTS AND DISCUSSION

West Lombok Regency is one of the regions in West Nusa Tenggara Province that has potential mineral resources, especially gold. Small-scale mining activities are widespread in Sekotong District, which consists of several villages with fairly intensive mining activities. The characteristics of the research area are shown in **Table 1**.

Table 1. Characteristics of the Research Area in West Lombok Regency

Indicator	Value
Area	1.053,92 km²
Population (2023)	748.000 people
Subdistrict where the mine is located	Sekotong
Number of villages in Sekotong Subdistrict	10 villages
Dominant economic sector	Agriculture, trade, services

3.1 The Development of Small-Scale Gold Mining in Sekotong

Small-scale gold mining activities in Sekotong District began to grow rapidly after the discovery of gold deposits by the community in the late 2000s. Since then, this area has become one of the centers of small-scale gold mining on the island of Lombok. Mining activities are generally carried out traditionally by the community using simple equipment and limited processing technology. Over time, these mining activities have not only involved the local community, but have also attracted workers from various regions.

The growth of mining activities has an impact on local economic dynamics, particularly through increased trade, transportation services, and small businesses developing around mining areas. However, most small-scale mining activities are still informal, so their contribution to regional income is not optimally recorded in official economic statistics.

3.2 Contribution of Mining to Regional Economic Growth

The contribution of the mining sector to the regional economy can be seen through Regional Gross Domestic Product (RGDP) data. Although small-scale gold mining activities are quite developed in the Sekotong region, the contribution of the mining sector to the GRDP of West Lombok Regency is still relatively small, at around two percent of the total regional economy (**Table 2**). This condition indicates that most small-scale mining activities are still informal in nature and therefore not optimally recorded in official economic statistics (Okwanya et al., 2023; Yang et al., 2023).

Table 2. Contribution of the Mining Sector to the Gross Regional Domestic Product of West Lombok Regency

Year	Total GRDP billion Indonesian Rupiah (IDR billion)	Sector Mining (%)
2019	15.320	2.01
2020	15.870	2.03
2021	16.540	2.05

Year	Total GRDP billion Indonesian Rupiah (IDR billion)	Sector Mining (%)
2022	17.230	2.07
2023	18.010	2.08

***Source**: BPS NTB*

This condition shows that the growing small-scale gold mining activity in the Sekotong region is not fully reflected in formal economic statistics. This is due to the characteristics of small-scale mining activities, which are mostly informal and therefore not officially recorded in the regional economic system. Nevertheless, the existence of mining activities continues to influence the local economy through economic activity among communities surrounding the mining area (Bogler et al., 2020).

3.3 Mining and Community Poverty Conditions

Small-scale gold mining is often seen as an alternative source of livelihood for communities in areas with limited employment opportunities. In Sekotong Subdistrict, mining activities have created job opportunities for the local community, thereby potentially increasing household income. However, this increase in economic activity has not always been accompanied by a significant reduction in poverty levels (Adekoya et al., 2022; Isung et al., 2021).

Table 3. Percentage of Poor Population in West Lombok Regency

Year	Population (people)	Poor People (people)	Percentage (%)
2019	712.000	94.800	13.31
2020	721.000	92.400	12.81
2021	728.000	92.100	12.65
2022	735.000	91.700	12.47
2023	742.000	92.600	12.48

***Source**:* Badan Pusat Statistik, 2023

Statistical data shows that the poverty rate in West Lombok Regency has remained relatively high in recent years. This indicates that the economic benefits of mining activities have not been fully and evenly felt by the community. In addition, dependence on the unstable mining sector can also cause economic vulnerability for communities that depend on these activities for their income.

3.4 The Impact of Mining on Environmental Quality

In addition to having economic and social impacts, small-scale gold mining activities also have the potential to put pressure on the environment. Traditional gold mining and processing methods often use chemicals such as mercury, which can contaminate the soil and water sources around the mining area. Furthermore, mining activities can also cause land degradation, changes to the landscape, and a reduction in vegetation cover (Famiyeh et al., 2020; Sonter et al., 2018).

Table 4. NTB Province Environmental Quality Index

Year	Water QI	Air QI	Land Cover QI	EQI
2019	53.8	87.9	60.2	67.1
2020	54.1	88.3	59.8	67.0
2021	55.0	89.1	58.7	66.9
2022	55.8	90.0	58.1	67.1
2023	56.2	90.4	57.9	67.3

***Source**:* NTB Satu Data

Note: All Environmental Quality Index values are expressed on a **scale of 0–100 (index score).**

The Environmental Quality Index (EQI) is one indicator that can be used to describe the environmental conditions of a region. A decline in several components of the EQI, particularly the land cover index, indicates pressure on the ecosystem, one of which is influenced by mining activities. Therefore, more sustainable management of mining activities is needed to minimize negative impacts on the environment while maintaining a balance between the use of natural resources and environmental sustainability.

3.5 Correlation Analysis of the Mining Sector with Poverty and Environmental Quality

A correlation analysis was conducted to examine the relationship between the contribution of the mining sector to the Gross Regional Domestic Product (GRDP) and the poverty rate and Environmental Quality Index (EQI) in West Lombok Regency. This analysis uses data from the 2019-2023 period as presented in **Table 2, Table 3,** and **Table 4**. The method used is simple linear regression to determine the direction and strength of the relationship between variables.

The results of the analysis of the relationship between the contribution of the mining sector to GRDP and the poverty rate are shown in Figure 1. Based on the regression results, the equation $y = -11.39x + 36.071$ % of GRDP was obtained with a coefficient of determination $R^2 = 0.8897$ (unitless) or around 0.8, which shows a strong relationship between the contribution of the mining sector to GRDP and the poverty rate in West Lombok Regency. The negative regression coefficient value indicates that an increase in the mining sector's contribution to the regional economy tends to be followed by a decrease in the poverty rate. This condition can be explained because small-scale mining activities are a source of livelihood for the local community, especially for low-income groups. Community involvement in mining and mineral processing activities provides additional income opportunities, thereby contributing to a decrease in the poverty rate in the region.

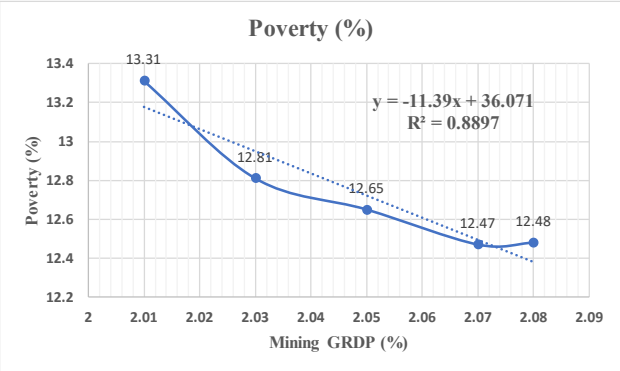

Image 1. Graph showing the relationship between the contribution of the mining sector to GRDP and poverty levels

Meanwhile, the results of the analysis of the relationship between the contribution of the mining sector to the GRDP and the Environmental Quality Index are shown in Figure 2. The regression results show the equation y = 2.378x + 62.21 % with a coefficient of determination value of R^2 = 0.2108 (unitless) or around 0.2, which indicates a relatively weak relationship between mining activities and environmental quality. This shows that changes in environmental quality are not entirely influenced by mining activities, but are also influenced by various other factors that affect regional environmental conditions.

However, traditional small-scale mining activities still have the potential to cause environmental pressure if not managed properly. In some small-scale mineral processing activities, the use of equipment such as glondongan and tong in the ore processing process has the potential to cause water pollution if the processing waste is not managed properly. In addition, the involvement of mining businesses in environmental rehabilitation efforts such as reforestation or post-mining land management is still relatively limited.

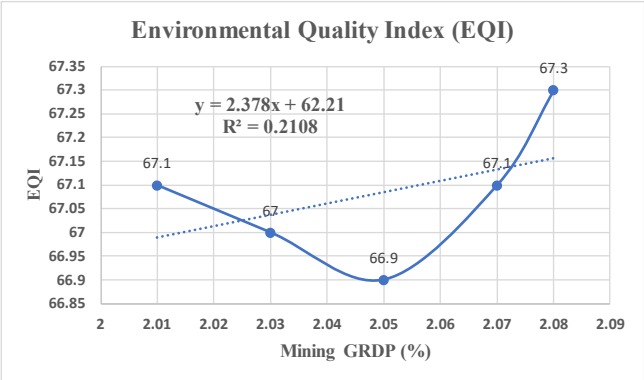

Image 2. Graph of the Relationship between the Contribution of the Mining Sector to GRDP and the Environmental Quality Index

Overall, the results of this analysis show that the mining sector plays a role in supporting community economic activities and has the potential to contribute to poverty reduction. However, the mining sector needs to be managed in a more sustainable manner so that any potential environmental impacts can be minimized, thereby maintaining a balance between economic growth and environmental sustainability.

4. CONCLUSION

The results of the study show that the small-scale mining sector in West Lombok Regency is linked to regional economic dynamics, although its contribution to the economic structure is still relatively small. Based on data from the 2019-2023 period, the contribution of the mining sector to the Regional Domestic Product (RDP) only ranges from 2.01% to 2.08% of the total regional economy. This condition indicates that some small-scale mining activities are still in the informal sector and are not fully recorded in official economic statistics.

The regression analysis results show that the contribution of the mining sector to the GRDP has a strong relationship with the poverty rate, with a coefficient of determination of around 0.8. An increase in the contribution of the mining sector to the GRDP tends to be followed by a decrease in the poverty rate in West Lombok Regency. This can be explained by the fact that small-scale mining activities are a source of livelihood for the local community, especially for low-income groups who are directly involved in mining and mineral processing activities.

Meanwhile, the relationship between the mining sector's contribution to GRDP and the Environmental Quality Index shows a relatively weak correlation with a coefficient of determination of around 0.2. This indicates that changes in environmental quality are not solely influenced by mining activities, but also by various other factors that affect regional environmental conditions. Nevertheless, traditional small-scale mining activities still have the potential to put pressure on the environment if they are not managed sustainably. The trade-off between economic benefits and environmental sustainability remains a key challenge in small-scale mining practices (Zubail et al., 2021).

5. LIMITATIONS & FUTURE RESEARCH

5.1. Limitations of the Study

This study has several limitations that need to be acknowledged. First, the analysis relies on secondary data from official institutions, which may not fully capture informal small-scale mining activities that are not recorded in formal statistics. Second, the study uses a relatively short time series (2019-2023), which may limit the robustness of long-term trend analysis. Third, the use of simple linear regression does not account for other influencing variables such as policy changes, environmental management practices, or external economic factors that may affect poverty and environmental quality.

5.2. Recommendations for Future Research

Future research is recommended to incorporate longer time series data and more comprehensive variables, including institutional, environmental governance, and technological aspects of mining activities. In addition, the application of more advanced analytical methods such as multivariate regression or system dynamics modeling could provide deeper insights into the complex interactions between economic growth, social welfare, and environmental sustainability. Further studies are also encouraged to include primary data

collection at the community level to better capture the real impacts of small-scale mining activities.

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