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Article

Developing a composite index for assessing policing in Indonesia's mining

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Abstract: The mining issue's real-world impact is directly linked to the insufficient policing efforts by relevant institutions, potentially affecting the credibility of law enforcement agencies and regional performance. This research project sought to evaluate policing performance related to mining activities in Indonesian regional areas. Using an indexing method, a composite index was developed based on supervision, partnership, and law enforcement aspects. This index functioned as a representation of policing within the mining and quarrying context. The evaluation was carried out in Indonesian provinces with active mining and quarrying operations. The composite index was then juxtaposed with regional gross domestic products to gauge the correlation between policing and regional economic performance. Results revealed that regions heavily reliant on mining for regional GDP, like East Kalimantan, South Sumatera, and Papua, tended to have lower policing indices due to shortcomings in supervision and law enforcement. Conversely, regions with stronger policing indices typically excelled in the supervisory dimension, as seen in Yogyakarta. The study suggests that engaging with communities and increasing the ratio of mine inspectors to mine areas can enhance mining governance and regional competitiveness. Boosting the number of mine inspectors in specific areas can also positively impact overall policing activities within mining regions.

Keywords: composite index; policing governance; regional competitiveness; sustainable development; mining and quarrying

1. Introduction

The mining industries make significant contributions to the economies of low and middle-income countries, such as those in Asia and Africa, accounting for 10%–20% of GDP (Ericsson and Lof, 2018). However, this economic reliance on the mining sector can lead to negative outcomes without proper governance. Waye et al. (2009) highlighted the critical role of governance in the mining sector for sustainable development. Their research indicated that governance, as measured by the regulatory quality index, and economic performance, as measured by GDP, collectively influence the investment climate in the mining sector. This suggests that both governance and economic performance are essential variables for evaluating regions dependent on mining. The importance of government involvement in mining governance is further supported by the study of Domínguez-Gomez and Gonzalez-Gomez (2021), emphasizing that governance in mining is vital for the effective management and sustainability of countries and regions reliant on mining activities.

In Indonesian context, the mining and quarrying sectors have a significant impact on Indonesia's regional landscape, influencing competitiveness in both beneficial and detrimental ways. To comprehend this intricate relationship, a deeper exploration is necessary. These sectors generate considerable revenue, contributing to the regional

GDP and government income through taxes and royalties. This supports infrastructure development, job creation, and economic activity in areas abundant in resources. However, unsustainable mining practices can result in deforestation, water and air pollution, land degradation, and loss of biodiversity. These environmental repercussions negatively affect communities, impede tourism potential, and undermine the region's long-term competitiveness. To optimize the positive effects of mining on regional competitiveness in Indonesia, several crucial strategies are imperative. These include robust governance frameworks that promote transparency, accountability, and community involvement in decision-making to ensure equitable distribution of benefits and combat corruption.

In today's context of mine management, the definition of regional competitiveness has evolved to encompass additional factors such as political stability, business facilitation, and adherence to legal regulations. This perspective resonates with Fang's (2022), definition of regional competitiveness, which emphasizes the capacity to navigate social, economic, and cultural markets. The investment climate and economic conditions are also influenced by political stability, institutional integrity, and legal compliance, as highlighted by Vásquez Cordano and Prialé Zevallos (2021).

Ensuring regulatory and legal compliance can be facilitated through policing efforts. The effectiveness of legal compliance is contingent upon the rule of law, which encompasses factors such as security, order, transparency in management, and enforcement of regulations (Botero and Ponce, 2011). This concept aligns with the core functions of policing, which traditionally involve maintaining social order, ensuring security, and preventing crime (Wood, 2020). However, policing also extends to broader territorial and spatial dimensions, making it adaptable and beneficial in various circumstances (Wood, 2020).

Adherence to regulations and legal requirements is essential for fostering the development of mining and quarrying sectors. Effective management of these activities is critical as their outcomes rely heavily on a country's ability to attract investments, maintain economic stability, and enhance regional competitiveness (Fang et al., 2022). Enhancing compliance through legal mechanisms has emerged as a key priority for nations to ensure economic stability within their territories. This emphasis on legal compliance is reflected in the political strategies of various countries, which allocate resources to support legal measures such as combating corruption, upholding human rights, and enhancing public access to security services (Botero and Ponce, 2011). Additionally, Goldstein et al. (2020), highlight the United States government's efforts to bolster the capabilities of law enforcement agencies. Census data from 2012 reveals that nearly 80% of American cities contributed 10% of the area's revenue, underscoring the significance of the rule of law in territorial governance.

The wide range of definitions related to mining and quarrying governance poses risks in terms of management, especially in the areas of supervision and control. Governance, as defined, refers to the way authority is implemented within a nation, encompassing various factors such as the government's ability to effectively manage resources through the establishment of sound regulations and policies. This concept is underpinned by the economic and social interactions between the government and its

populace (Kaufmann et al., 2000). The governance of mining and quarrying operations falls within this overarching definition.

Regarding supervision and control, challenges exist with legal breaches and non-adherence to regulations in the management of mining and quarrying operations. These extractive activities give rise to a myriad of issues, spanning environmental concerns to legal matters like labor abuse and unauthorized use of hazardous chemicals (Hammond, 1988; Meutia et al., 2023; Salemdeeb et al., 2016; Zhang et al., 2022). Meutia et al. (2023) highlighted an instance of legality and environmental issues stemming from illicit mining practices in Kenya. In Kenya, alarming statistics reveal that 97% of gold mining operations involve mercury use, 95.5% operate without proper permits, and 94.3% fail to conduct environmental assessments during mining activities. Furthermore, even when a mine operates within the legal framework, it may still encounter challenges associated with non-compliance with regulatory standards, as exemplified in a Colombian gold mine.

Non-compliance with mining management provisions leads to detrimental impacts on the community, such as accidents and environmental degradation. Agnew et al. (2009) provide an insightful overview of the repercussions of illegal use of natural resources, focusing on fishing. According to Agnew, illegal fishing not only results in the unsustainable depletion of natural resources but also imposes significant economic and environmental burdens (Agnew et al., 2009; Vince et al., 2021). Furthermore, the problem of law violations directly affects the economy of a region. Tang (2009) demonstrated that inflation and unemployment rates are positively correlated with the increase in crime in Malaysia (Foon Tang, 2009; Smith and Hickman, 2022).

The passage presents several research problems concerning governance in mining and quarrying. Firstly, the definition of regional competitiveness in mining management lacks consensus, extending beyond economic factors to encompass political stability, business facilitation, and regulatory compliance. Secondly, the effective enforcement of mining regulations relies heavily on the rule of law, which includes security, transparency, and enforcement mechanisms, yet achieving this can be difficult. Thirdly, the broad scope of mining governance poses challenges in supervision and control, with weak policing and management practices leading to legal violations and non-compliance with regulations. These issues underscore the necessity for a standardized approach to mining governance, enhanced enforcement mechanisms, and improved policing efforts to promote sustainable and responsible mining practices.

Assessing policing activities in mining and quarrying regions can enhance these efforts and contribute to the advancement of the area. Effective governance in mining and quarrying plays a crucial role in driving economic growth, positively impacting both macro and microeconomic aspects of the community, such as boosting employment opportunities and regional income (Asmiani et al., 2023). By measuring actions taken to support progress, these favourable conditions can be further enhanced. In the realm of policing, Hodgkinson et al. (2019) highlights the United Kingdom's utilization of policing performance metrics over several years to drive police reforms. The measurement of policing activities in mining and quarrying operations is essential

for raising awareness, particularly concerning compliance with environmental laws and enhancing oversight and control (Massaquoi et al., 2021).

Based on the previously described conditions, the following research questions have emerged:

1) How mining-based regions perform among each other measured by policing governance dimension of supervision, partnership, and law enforcement dimensions.

2) How do the various aspects of policing (supervision, partnership, law enforcement) contribute to performance index?

3) Are there any regional disparities between policing effectiveness measured by composite index and economic performance measured by regional GDP in mining areas?

There is limited research on how policing affects mining operations, particularly in terms of economics and regional planning. This area of study is lacking, despite the fact that mining and quarrying activities are consistently influenced by economic, technological, environmental, and social factors (Bloodworth et al., 2009). Evaluating the influence of policing on mining activities at the regional level is crucial, especially for tracking the advancement of these activities for development and regional planning purposes (Rahma et al., 2019).

In addition, to this date, there's a lack of scholarly analysis on how mining activities are policed and governed, especially in developing countries. This is a significant oversight because mining can have major social, economic, and environmental consequences. This research is the first to address this gap by examining policing governance in relation to mining activities in developing countries. This research uses a composite index, which is a tool that combines multiple indicators into a single score. This will allow us to comprehensively assess different aspects of policing governance related to mining.

This study plays a crucial role in evaluating policing efforts in the mining sector in Indonesia through the creation of a composite index. One key rationale for conducting this assessment is the limited capacity of the Central Government of Indonesia to effectively oversee and regulate illegal mining activities. This deficiency in government oversight stems from regulations that restrict mining inspectors to monitoring legal mines exclusively. As a result, the task of combating illegal mining falls on other agencies, such as the police and anti-corruption bodies (Jhanattan et al., 2023). Therefore, utilizing the composite index, as employed in various studies on public governance (Dialga and Ouoba, 2022), proves advantageous for consolidating numerous intricate variables into a single indicator (Dialga and Vallée, 2021).

While the approach offers the advantage of simplicity and the ability to offer valuable insights into policing governance in mining activities and its impact on regional development, it does have limitations. These include a restricted use of governance variables and limited data availability. These limitations and strategies to address them will be further elaborated upon in the conclusion section.

The study aims to assess policing practices in mining regions, identify what makes them effective, and explore how effective policing might be linked to economic success in these areas. Specifically, the objectives of this study are:

1) To compare the performance of mining-based regions in terms of three policing governance dimensions: supervision, partnership, and law enforcement. This

involves assessing how well each region performs relative to others in each of these dimensions.

2) To understand the relative contribution of each policing dimension (supervision, partnership, law enforcement) to an overall policing performance index. This will help identify which aspects of policing are most critical for effective policing in mining regions.
3) To investigate the relationship between policing effectiveness and economic performance in mining areas. In so doing, it will map the position of regions in a quadrant form with respect to their composite policing index and their economic performance measured by their regional GDP.

The paper is organized into four sections. Following the Introduction, section 2 details the materials and methods used to develop the composite index, including its variables and measurement. Section 3 presents the study's results and includes visual representations of some key findings. Finally, in Section 4, the study's conclusions are provided, summarizing the findings and discussing the scientific and practical implications, as well as suggesting directions for future research in the field

2. Materials and methods

An evaluation of effective policing governance in the mining and quarrying sectors was conducted through the development of a composite index. Utilizing a composite index offers the advantage of consolidating numerous data points into a single, simplified metric. This simplification aids in comprehending complex situations quickly. Policing governance encompasses various aspects such as reporting, monitoring, and law enforcement. The use of a composite index allows for the simplification of such measurements into a single number. Furthermore, by providing a standardized metric, composite indexes facilitate easier comparison and ranking across different entities, such as different provinces in this case. This comparative analysis can assist policymakers in assessing the effectiveness of governance in managing the mining sector within the country. The study combines secondary data with primary data to determine weighting factors for constructing the composite index.

The dimensions of policing governance in mining activities encompass supervision, partnership, and law enforcement. Within the supervision dimension, factors include the ratio of police officers to the population, the ratio of mine inspectors to mining site area per province, and other relevant metrics. Partnership indicators consist of the percentage of crime victims who report incidents to the police and the number of crimes reported per total population. The law enforcement dimension covers aspects such as the percentage of crimes compared to the population and the percentage of mining and quarrying-related crimes that have been prosecuted relative to total crimes in a given area. These dimensions and indicators were selected based on their significance in policing governance and data availability. For instance, the number of police per population reflects the overall police presence, which can impact crime prevention and response times. In mining regions, a heightened police presence may be necessary due to security concerns. Similarly, crime reporting rates indicate the level of trust between the community and law enforcement. Higher reporting rates suggest a strong community-police relationship, facilitating investigations and crime

trend identification. Regarding law enforcement, metrics like crime percentage compared to the population serve as direct measures of crime prevalence, informing the need for increased policing efforts in mining areas with high crime rates.

To develop a policing composite index, the study involves various steps, starting from data gathering, normalization, weighting and aggregation. **Figure 1** presents the proses of developing index:

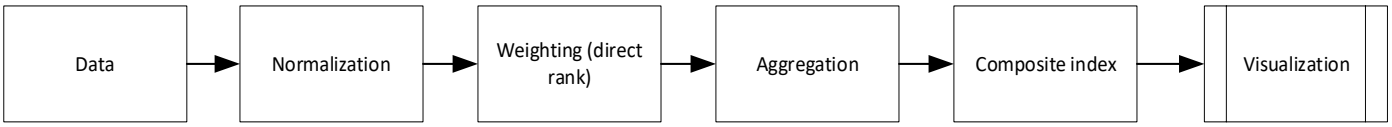


Figure 1. Stages in calculating policing composite index.

The data used in this study are secondary data gathered from the Ministry of Energy and Mineral Resources (ESDM), the police, and the Central Bureau of Statistics (BPS). The data set are processed into variables that describe the three dimensions of policing in mining namely management supervision, partnership, and law enforcement (Saile, 2003). The data used is from year 2021 covering all provinces in Indonesia except Jakarta, since it doesn't have mining activities. The dimensions and variables used in this study are as shown in the **Table 1** below:

Table 1. Composite index variables.

Dimension	Indicator	Unit/code/Polarization	Source
Supervision (SPV)	Ratio of number of police per population (RATIO)	Ratio/X1.1/Positive	BPS/(processed)
X1	Number of easily accessible police posts per area in Indonesia (POSPOL)	Ratio/X1.2/Positive	BPS/(processed)
	Community Risk of Crime per 1000 Population (RESMASY)	Ratio/X1.3/Negative	BPS/(processed)
	The ratio of mine inspectors to mining site area per province (INST)	Ratio/X1.4/Positive	ESDM Database/(processed)
	Percentage of legal entity excavation business (BUH)	Percentage/X1.5/Positive	ESDM mining Statistics/(processed)
Partnership (PARTNER)	Percentage of villages that build police posts independently (POSMANDIRI)	Percentage/X2.1/Positive	BPS/(processed)
X2	Percentage of crime victims who report to the Police (LAPMASY)	Percentage/X2.2/Positive	BPS/(processed)
	Number of crimes reported per total population (TOTALLAP)	Ratio/X2.3/Positive	BPS/(processed)
Law enforcement (ENF)	Percentage of crime compared to population (CRIME)	Percentage/X3.1/Negative	Police Database/(processed)
X3	The percentage of mining and quarrying-related crimes that have been prosecuted compared to the total crimes in an area (CSIDANG)	Percentage/X3.2/Negative	Police Database/(processed)
	Percentage of mining and quarrying crime handling stopped by police compared to total crime (CHENTI)	Percentage/X3.3/Negative	Police Database/(processed)

Regarding the weighting process, it is conducted by a panel comprising qualified individuals, including former high-ranking officials from Ministries and Institutions with expertise in the mining and quarrying sector in Indonesia. This panel consists of

eight experts. The method employed for index calculation involves direct rank weighting based on expert assessments, which is subsequently combined with centroid order rank techniques (Hatefi, 2023; Kunsch and Ishizaka, 2019; Saputra, 2020) as seen on **Table 2**.

Table 2. Dimensional weights and indicator weights used for index calculations.

Dimension	Dimensional weights	Indicators	Indicators weights
(SPV)	0.61	(RASIO)	0.12
		(POSPOL)	0.14
		(RESMASY) (−)	0.16
		(INST)	0.34
		(BUH)	0.25
(PARTNER)	0.19	(POSMANDIRI)	0.11
		(LAPMASY)	0.44
		(TOTALLAP)	0.44
(ENF)	0.19	(CRIME) (−)	0.22
		(CSIDANG)	0.61
		(CHENTI)	0.17

The rationale for assigning varying weights to each dimension and indicator is based on the differing levels of importance attributed to each dimension. Experts assert that certain dimensions, such as supervision, are deemed more critical in the context of policing governance. Although all three dimensions (supervision, partnership, and law enforcement) are essential for effective mining governance, supervision may be considered relatively more significant for several reasons. Supervision is focused on proactively preventing issues before they manifest. Inspectors ensure adherence to safety protocols and environmental regulations, potentially averting accidents and environmental harm. This emphasis is also reflected in the higher weight assigned to the ratio of mining inspectors to mining sites per province (INST) compared to other indicators within the supervision dimension. In contrast, law enforcement and partnership, while important, tend to be more reactive in addressing problems post-occurrence. While robust law enforcement can act as a deterrent to crime, supervision aims to preclude the circumstances that could lead to criminal activities in the first place.

Since indicators contain positive and negative polarizations, the normalization procedure should be carried out. Normalization of the data for each criteria was carried using the min-max method as shown in Equation (1).

$$X_{kq} = \frac{X_{qc} - min_c(x_q)}{max_c(x_{qc}) - min_c(x_{qc})} x100 \quad (1)$$

where X_{qc} is the q indicator value for region c. If the criteria has negative polarity or bad indicator (the less the better) the normalization was carried using Equation (2).

$$X_{kq}^{(-)} = 100 - (\frac{(X_{qc}) - min_c(x_{qc})}{max_c(x_{qc}) - min_c(x_{qc})} \times 100) \quad (2)$$

The next step of calculation is to calculate the weighted criteria. The weighted criteria for composite indices were calculated using the subjective method and direct ranking. The expert panel's opinion is weighted using the Centroid Rank Order (ROC) method as shown Equation (3).

$$W_{kq} = \frac{1}{n}\sum_{k=1}^{n}\left(\frac{1}{k}\right) \quad (3)$$

where W_{kq} is the weight of the q-th indicator, the k-th dimension, and n is the number of indicators of all dimensions to be ranked.

Index aggregation was carried out by multiplying normalized data by weights, namely X1.1, X1.2, and X3.3. with weights W1.1, W1.2, W3.3. The aggregation formula is as follows:

$$I_j = \sum_{i=1}^{n}(X_{kq} \times W_{kq}) \quad (4)$$

where I_j is the value of the composite index in the jth region (province).

The data analysis uses graph visualization methods, comparing index score data of each region and comparing index scores with economic data in the area.

3. Results and discussion

3.1. Results

Table 3 presents policing composite index for 33 provinces in Indonesia based on three dimension i.e., supervision, partnership and law enforcement components. The order of presentation is based in the geographical location in Indonesia from the western part of the country (i.e., Aceh) all the way to the easternmost of the country (Papua).

Table 3. Composite index calculation results.

Id	Province	Supervision index	Partnership index	Law enforcement index	Composite index
1	Aceh	27.10	60.84	73.28	42.64
2	North Sumatera	22.40	41.56	12.98	24.29
3	West Sumatera	24.39	47.88	24.53	28.98
4	Riau	21.61	30.56	24.83	23.97
5	Jambi	22.92	38.03	51.91	31.49
6	South Sumatera	20.11	45.25	16.70	24.33
7	Bengkulu	21.79	31.95	31.46	25.65
8	Lampung	31.92	25.64	24.99	29.35
9	Bangka-Belitong	31.74	54.04	34.76	36.66
10	Riau Islands	28.89	53.89	14.38	30.93
11	West Java	33.09	55.56	41.20	39.04
12	Central Java	33.80	18.91	48.06	33.68
13	Yogyakarta	66.26	59.69	7.51	53.56
14	East Java	27.85	32.97	30.94	29.44
15	Banten	40.95	41.93	24.91	38.02

Table 3. (*Continued*).

Id	Province	Supervision index	Partnership index	Law enforcement index	Composite index
16	Bali	31.20	44.78	44.69	36.47
17	West Nusa Tenggara	21.22	45.36	15.63	24.83
18	East Nusa Tenggara	21.61	24.57	23.41	22.54
19	West Kalimantan	43.11	35.70	62.03	45.35
20	Central Kalimantan	22.88	55.52	46.84	33.88
21	South Sulawesi	22.94	51.27	22.20	28.30
22	East Kalimantan	21.06	51.52	25.80	27.91
23	North Kalimantan	22.34	66.54	28.85	32.20
24	North Sulawesi	23.83	75.06	5.69	30.26
25	Southeast Sulawesi	24.01	75.77	27.71	34.79
26	South Sulawesi	32.54	68.88	13.17	35.84
27	North Sulawesi	23.18	54.34	39.32	32.38
28	Gorontalo	17.27	61.23	8.02	24.02
29	West Sulawesi	23.74	47.45	18.18	27.27
30	Maluku	22.24	54.53	3.79	24.93
31	North Maluku	23.81	16.01	19.99	21.55
32	West Papua	14.45	78.40	1.79	24.42
33	Papua	20.87	62.62	11.21	27.11

A visual representation the ranking of policing index is shown in **Figure 2**.

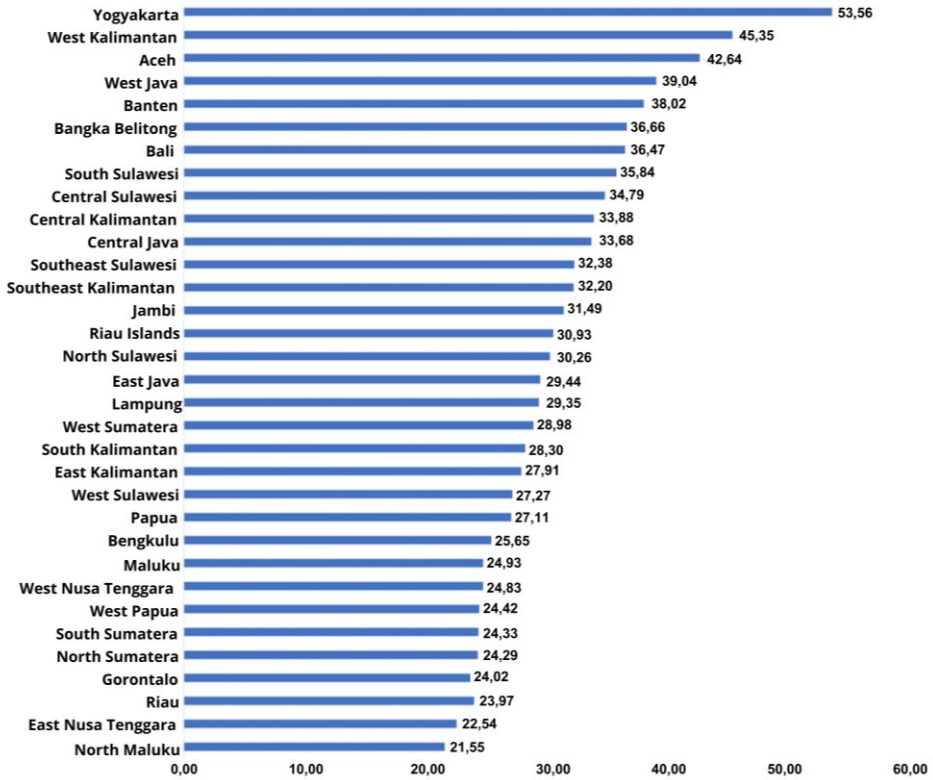


Figure 2. Bar chart of policing index in ascending order.
(Source: Authors' own source).

Figure 2 shows the scores; based on the data processed into a composite index, Yogyakarta is the region with the highest index score. The composite index comprises several variables and indices that describe the condition of an object under study (Mukhopadhyay et al., 2023). The score of 53.56 obtained by Yogyakarta is an aggregation of index values derived from secondary data related to policing activities in the mining area, namely supervision, partnership, and law enforcement. It shows that the performance of policing and other institutions in supervision, mining, and quarrying is excellent compared with other areas in Indonesia. A visualization of the policing index broken down into three components can be seen in **Figure 3**.

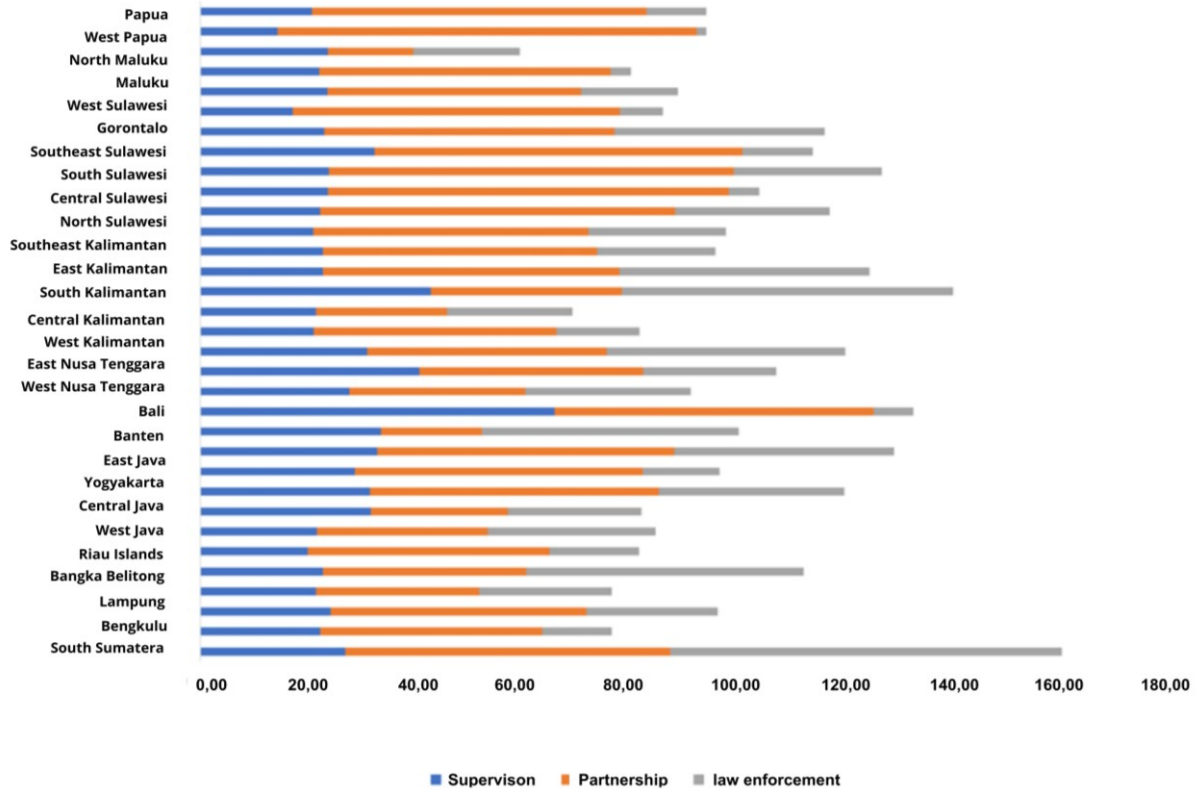


Figure 3. A Stacked Column histogram index of each dimension forms a regional composite index. (Source: Author's own source).

As can be seen from **Figure 3**, the high index score in regions such as Yogyakarta is influenced by the variable score of supervision and partnership carried out by the police agency and the Ministry of Energy and Mineral Resources. This finding aligns with several other studies discussing Yogyakarta regarding security and policing. Yogyakarta is known as an area whose people have particular characteristics (Casmini and Supardi, 2020; Nofrima et al., 2021; Park, 2012), allowing preventive policing to be carried out correctly (Boqué et al., 2022; Ellefsen et al., 2023; van der Giessen and Bayerl, 2022).

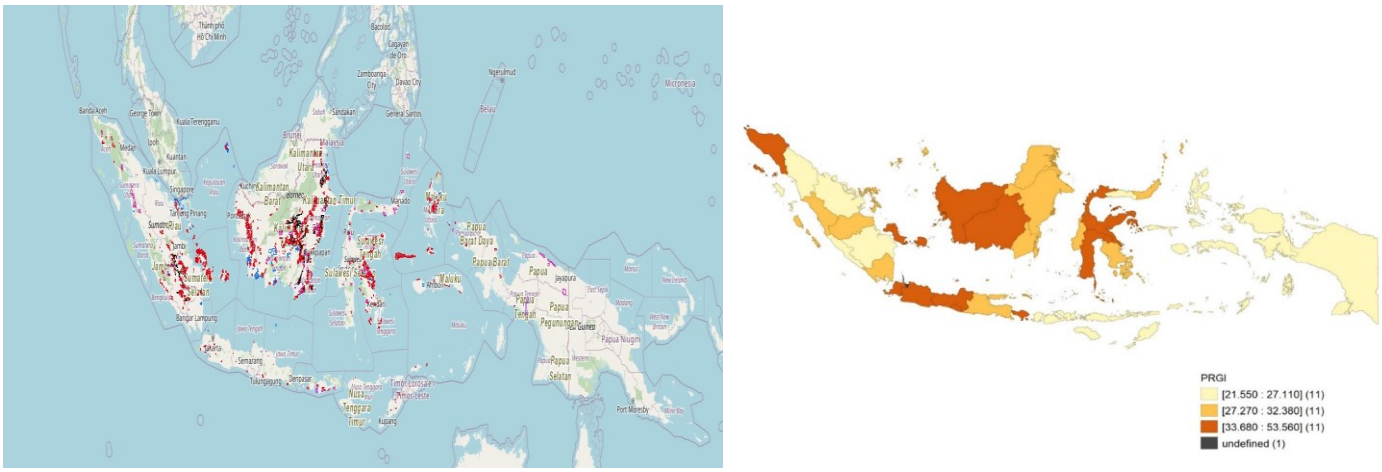
In addition, Yogyakarta has advantages, among others, a relatively high level of human resource performance indicated by a Human development index score of 77.6 (Rahma et al., 2019). The high score of the human development index, which consists of several variables, including income and education in the Yogyakarta area, impacts the characteristics of the Yogyakarta community, which strongly prioritizes the

concept of prevention. In addition, the high score of mining and policing in Yogyakarta is also inseparable from the independent dependence of the Yogyakarta economy on the mining and quarrying business (Hindersah et al., 2018; Rachman et al., 2023). It can be seen in the value of Yogyakarta's gross regional domestic product share, which is only worth 0.46% of the total gross regional domestic product of 107.3 trillion.

Some regions that do not have high supervision scores, such as Aceh and West Java, also have high composite index scores. The dimensions that contribute to the high score are law enforcement and partnership scores. It indicates a trade-off between a reasonably high level of community participation in policing activities (Quintero Cordero, 2020; White et al., 2021; Young, 2022) and good performance from law enforcement officials in handling mining and quarrying cases.

In the Stacked Column Histogram above (**Figure 3**), it can also be seen that those areas with a high share of GDP from mining and quarrying, such as East Kalimantan, Papua, South Kalimantan, and South Sumatra, have a low supervisory index, which contributes to the low composite index score. East Kalimantan, with a supervisory index score of 21.06; South Sumatra, with a supervisory index score of 20.11; and Papua, with a supervisory index score of 20.87, have the bottom five supervisory index scores of all provinces.

Figure 4 Compares areas with high mining and quarrying activities (**Figure 4a**) with the composite index score of policing mining and quarrying activities (**Figure 4b**). Ideally, high mining activity should be balanced with good supervisory and control management, but the comparison on the spatial map above shows the opposite (Meutia et al., 2023; Musviyanti et al., 2022).



(a) **(b)**

Figure 4. Comparison of regions with mining activities and policing composite index.

One of the regions, namely East Kalimantan, is an area that has high mining and quarrying activities but a low composite index score. It is consistent with the violation of law and disregard for regulations related to mining activities in the area. For example, a United Nations working group report considers a human rights violation done by transnational corporations in mining and quarrying in east Kalimantan. This

report states that these corporations neglect the accidents that caused the deaths in mine sites (Toumbourou et al., 2020).

Figure 5 presents a four-quadrant graph of index values compared to the gross domestic and regional product share value derived from mining and quarrying. The x-axis is the percentage share of Regional Gross Domestic Product (RGDP) from mining and quarrying, while the y-axis is the composite index score of policing mining and quarrying activities per region. The axis slice refers to the median value of the composite index with a value of 29.44 and a figure of 10% of the RGDP share value from mining and quarrying.

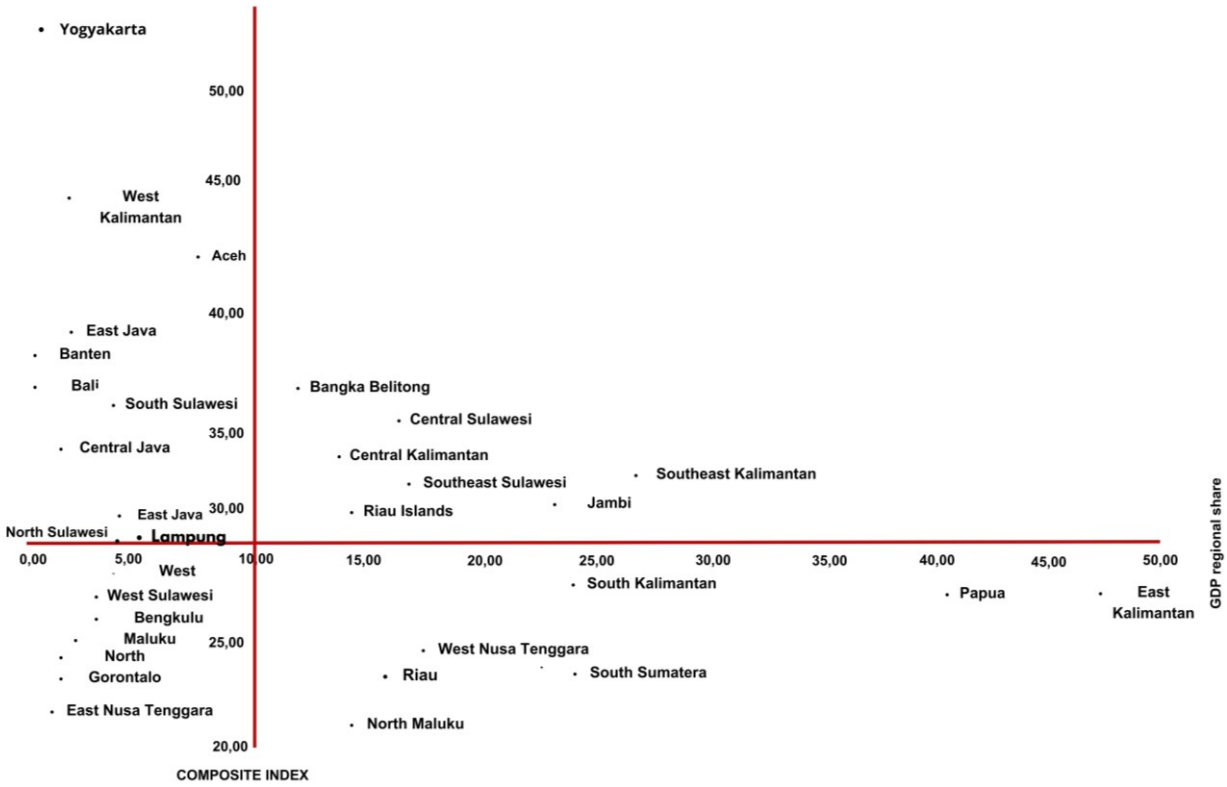


Figure 5. Regional GDP versus policing index.

From this visualization, although Yogyakarta has the highest index score, the area is in the left quadrant, which means that the share value of RGDP from mining and quarrying products is less than 10%. However, several areas with a share of mining and quarrying RGDP above 10% are in the lower right quadrant, including East Kalimantan, Papua, South Sumatra, and Riau. The data shows that the level of supervision, partnership, and law enforcement in mining and quarrying management activities in this area are weak.

3.2. Discussion

The contradiction observed when comparing composite index values in regions with significant mining and quarrying activities aligns with prior research, particularly discussions on the natural resource curse. The resource curse hypothesis elucidates various reasons why countries abundant in resources may struggle economically, a concept applicable at the regional level. Indonesia's challenges in governing mining

and quarrying operations stem from factors like inadequate economic governance and institutional quality (Hayat and Tahir, 2021; Rahim et al., 2021; Rahma et al., 2019). Numerous elements impact the effectiveness of institutional governance, with policing activities often influenced by local officials or individuals (Miller, 2023). While policing plays a crucial role in averting resource curses from an institutional standpoint, there is recognition of the necessity for decentralized authority in overseeing various sectors, including policing in mining and quarrying activities (Jones and Lister, 2019).

Inadequate institutional practices within the overseeing bodies responsible for regulating mining activities in this research contribute to legal breaches and non-adherence in the management of mining and quarrying operations. Furthermore, the study reveals a connection between substandard mining management and partnerships within each region. The significance of partnerships lies in fostering community engagement to incorporate the local population in strategic plans, initiatives, and projects aimed at enhancing regional security through preventive strategies rather than punitive actions, as exemplified in the Yogyakarta region (Quintero Cordero, 2020).

This information is evident from the data obtained from the composite index mentioned earlier. Analysis of the composite index results reveals that certain regions, such as East Kalimantan, South Sumatra, Papua, and Riau, which have a significant contribution to the gross domestic product from the mining sector, exhibit relatively lower index scores. For instance, South Sumatra has a score of 24.33, placing it among the top 10 provinces with composite index scores for overseeing mining activities. Despite this, the region's mining and quarrying sectors contribute substantially to the overall gross regional domestic product, accounting for 22% in 2021.

Figure 3 shows that regions like East Kalimantan, Papua, South Kalimantan, and South Sumatra, which rely heavily on mining and quarrying for their gross regional domestic product, have low supervisory index scores. This factor leads to their low composite index scores. Specifically, East Kalimantan has a supervisory index score of 21.06, South Sumatra has a score of 20.11, and Papua has a supervisory index score of 20.87, placing them among the provinces with the lowest supervisory index scores.

A key factor influencing the low supervisory index score in East Kalimantan, Papua, and South Sumatra is the insufficient ratio of mining inspectors to the areas requiring supervision in mining and quarrying. Mining inspectors play a vital role in enforcing governance in the mining sector in Indonesia. This supervisory role encompasses overseeing mining governance, ensuring occupational safety and health standards in mining zones, providing technical supervision, managing environmental aspects, and monitoring post-mining activities, as outlined in Indonesia's law number 3 of 2020 regarding mineral and coal mining.

The crucial responsibilities of mine inspectors play a significant role in mining governance. In regions like East Kalimantan, South Sumatra, and Papua, where there is an imbalance between the number of mine inspectors and the areas requiring supervision in mining and quarrying, the oversight of mining activity managers is weakened. This stands in contrast to Yogyakarta, where the percentage of mine inspectors compared to the number of mining areas exceeds 30%, leading to a positive impact on the overall supervisory index score.

Yogyakarta is the region that has the highest composite index score, with a score of 53.56. Yogyakarta is not the region that gets the largest share of gross regional

domestic product from the mining and quarrying sector but has a high ratio score of mine inspectors compared to mining and quarrying areas. (0.373). That is, the supervisory index has the most immense contribution to the high score of the composite index in Yogyakarta.

Furthermore, **Figure 3**'s Stacked Column Histogram highlights the notable presence of elevated composite index scores in various regions, including Yogyakarta, Aceh, and West Java, attributed to positive contributions from partnership and law enforcement indices. This suggests a balance between significant community engagement in policing endeavors and effective law enforcement responses to mining and quarrying incidents.

The finding of this study also reveals that law enforcement challenges in regions where quarrying and mining contribute substantially to the GDP exert significant economic influence in these mining areas. This influence is predominantly associated with issues such as corruption and the presence of mining syndicates. Mining and quarrying operations are intricate endeavors, not only due to their operational complexities but also due to their environmental and socio-economic ramifications. Nonetheless, these activities also yield beneficial economic impacts on regional economies. Therefore, effective regulation concerning licensing and implementation oversight is imperative for this sector (Tegnan et al., 2021).

In areas with poor supervision, control, and law enforcement in mining operations, the mining mafia engages in illegal activities through the manipulation of documents or disregard for environmental conservation regulations to maximize profits (Jhanattan et al., 2023). Studies in Indonesia and Brazil have shown that corruption and bribery are commonly employed by the mafia to exploit natural resources. In Indonesia, it is reported that over 70% of certain resource extraction activities, such as unauthorized logging, are facilitated through corrupt practices (Bullock et al., 2010).

To understand the impact of law enforcement efforts in mining and quarrying sectors, it is crucial to conduct research on quantifying policing activities. By employing a composite index score to evaluate law enforcement in these operations across different regions, we can assess the link between policing efforts and the region's economic performance, which in turn influences its competitiveness.

This research is relevant based on various criteria of research relevance. Firstly, it addresses the importance of the issue at hand, focusing on the impact of weak law enforcement on corruption and illegal activities within the mining and quarrying sectors. These activities have far-reaching consequences, such as environmental degradation and economic instability. Secondly, the research is relevant in terms of bridging a gap in knowledge. It delves into the relationship between law enforcement effectiveness and economic outcomes in mining regions, proposing a method (composite index score) to quantify policing efforts and evaluate their influence on regional economies. Thirdly, the findings offer valuable insights for policymakers to develop more effective law enforcement strategies in mining areas, potentially leading to reduced corruption, enhanced environmental protection, and greater economic stability. The research introduces a novel approach (composite index score) to gauge law enforcement initiatives in mining regions, serving as a valuable tool for future research and policy formulation. In conclusion, this research is pertinent as it addresses a critical issue, fills a knowledge void, and has the potential to enhance law

enforcement and economic outcomes in the mining and quarrying sectors, with broader implications.

4. Conclusion

The study investigated the relationship between better governance in mining-based industries and regional economic performance in Indonesia. It explored key questions about the competitiveness of regions reliant on mining, specifically in terms of governance effectiveness measured through supervision, partnership, and law enforcement using a composite index. This research represents the first of its kind in Indonesia on this topic.

Findings from this study show that the regions of Yogyakarta, West Kalimantan, Aceh, and West Java display the highest composite index scores. This significant index is primarily driven by strong supervision, notably reflected in the mine inspector-to-supervisory area ratio indicator. On the other hand, regions with a substantial contribution to the mining and quarrying Gross Regional Domestic Product (GRDP), such as East Kalimantan, Papua, and Riau, exhibit lower composite index scores due to weaker performance in the supervision and law enforcement dimensions.

In order to improve mining governance and increase regional competitiveness, it is important to engage community. Increasing community engagement in reporting crimes within the mining sector is crucial to boosting the index in regions with a dominant GDP share from mining and quarrying. Community involvement will contribute to balancing the law enforcement dimension overseen by the police. Furthermore, to encourage the public to report crimes, authorities must enhance their responsiveness to community reports.

Enhancing the ratio of mine inspectors to mine area from an institutional standpoint enhances the supervisory rating. Augmenting the quantity of mine inspectors in a given area can have a beneficial impact on all policing activities within mining and quarrying regions. Furthermore, it is imperative to enhance the efficacy of supervisory institutions, like the police, to ensure a consistent execution of supervisory duties, both in a preventive and punitive manner, thereby creating a deterrent effect for individuals engaging in violations of mining and quarrying regulations in Indonesia.

This study offers significant insights into policing governance within the mining sector and its impact on regional economic development in Indonesia. A key scientific contribution of this research is its pioneering examination of the relationship between mining governance effectiveness and regional economic performance in Indonesia. This study sets a foundation for future research and enables comparisons with other resource-dependent regions worldwide. Additionally, the study introduces a composite index to evaluate governance effectiveness in the mining sector, focusing on supervision, partnership, and law enforcement. This index serves as a valuable tool for researchers to assess governance enhancements.

In terms of practical implications, the research presents actionable policy recommendations to enhance mining governance in Indonesia. It underscores the importance of community involvement in reporting mining-related offenses to bolster law enforcement and enhance overall governance ratings. The study also underscores the necessity of reinforcing supervision by increasing the number of mine inspectors

and enhancing the efficiency of supervisory bodies to improve oversight and deter violations. By enhancing policing governance in the mining sector, the study suggests that regions can enhance their competitiveness in the mining industry, leading to increased economic advantages for these areas.

The findings from the aforementioned conclusions indicate that the research can be effectively utilized to assess the enhancement of mining and quarrying governance performance in Indonesia, aiming to attain regional competitiveness in the sector.

This study is constrained by certain limitations, including its inability to comprehensively depict all facets of mining and quarrying governance in Indonesia, focusing solely on variables associated with policing, encompassing supervisory, partnership, and law enforcement activities. This limitation could be overcome by incorporating more variable related to governance such as … Moreover, limitations exist regarding the accessibility of data sets, leading to the utilization of data solely from the year 2021, during which comprehensive mining and quarrying management data in Indonesia was readily accessible for incorporation into the composite index. Such constrains could be overcome in future research by incorporating mixed secondary and primary data. Similarly future research might utilize time series data from several years, however such data might available for different indicators, hence the composite index measurement should be adjusted accordingly.

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