JURNAL LOCUS: Penelitian & Pengabdian
Volume 4 No. 6 Juni 2025
E-ISSN 2829-7334| P-ISSN 2829-5439
Hompage: https://locus.rivierapublishing.id/index.php/jl

Descriptive Analysis of Environmental and Community Practices in the Indonesian Mining Sector: Contributions to Sustainable Development Goals

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Abstract:
Sustainable development in the mining sector demands comprehensive practices that ensure environmental preservation and empower local communities. This study aims to descriptively analyze the implementation of Environmental Sustainability Practice (ESP) and Community Development Practice (CDP) in Indonesian mining companies, highlighting their contribution to achieving the Sustainable Development Goals (SDGs). Utilizing a descriptive-analytical approach, primary data were collected through surveys distributed to operational managers across various mining sites. Statistical indicators such as mean, standard deviation, variance, skewness, and kurtosis were employed to examine patterns and variability. The findings reveal that ESP initiatives are moderately implemented, reflecting a consistent effort toward environmental management and resource conservation, whereas CDP shows uneven performance, particularly in stakeholder engagement and socio-economic development programs. Discussions underscore geographical disparities and commodity-specific influences that affect the effectiveness of these practices. It is concluded that, although mining companies have made notable progress towards sustainable practices, significant gaps remain in optimizing community development outcomes. Strengthening regulatory frameworks and encouraging best-practice adoption are crucial to closing these gaps. This study provides empirical insights for policymakers, industry practitioners, and researchers striving to advance sustainable mining operations in emerging economies.

Keywords: Environmental Practices; Community Practices; Sustainable Development Goals; Mining Sector; Indonesia; Descriptive Analysis

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INTRODUCTION

The mining sector plays a pivotal role in the economic development of emerging economies, including Indonesia. As a nation endowed with abundant natural resources, Indonesia has witnessed a substantial contribution from the mining industry toward national GDP, employment creation, and regional development (Hilson, 2012). However, alongside these benefits, mining activities have raised significant environmental and social concerns, necessitating a balanced approach that integrates economic growth with sustainable environmental and community practices (Bebbington et al., 2008). Recent global frameworks such as the United Nations' Sustainable Development Goals (SDGs) emphasize the importance of aligning industrial activities, including mining, with environmental preservation and

community empowerment (United Nations, 2015). Within this context, Environmental Sustainability Practice (ESP) and Community Development Practice (CDP) have emerged as critical components for sustainable mining operations.

Over the past decade, numerous studies have highlighted the detrimental environmental impacts of mining, including land degradation, biodiversity loss, and pollution of water resources (Bridge, 2004; Hamman, Anquetin, & Monicolle, 2017). Simultaneously, the social dimensions, particularly community displacement, health risks, and socio-economic inequalities, have garnered increasing attention (Allen et al., 2001). In Indonesia, the decentralized governance structure and diversity in geographic and socio-economic conditions further complicate the implementation of sustainable practices (Aspinall & Fealy, 2003). Therefore, it is imperative to investigate how mining companies operationalize ESP and CDP within the Indonesian context, contributing to a broader understanding of sustainability in resource-intensive industries.

Despite extensive discussions on sustainable mining, several challenges persist. A key issue lies in the inconsistent adoption and execution of environmental and community-focused initiatives across mining companies (Franks, Brereton, & Moran, 2013). While multinational corporations often implement comprehensive sustainability programs, smaller local operators frequently exhibit minimal compliance, driven by resource constraints and weaker regulatory oversight (Jenkins & Yakovleva, 2006). Moreover, geographical disparities and commodity-specific practices add layers of complexity to the achievement of uniform sustainability standards (Robinson, 2017).

The general solutions proposed in the literature to address these challenges include strengthening environmental governance, enhancing corporate social responsibility (CSR) frameworks, and fostering multi-stakeholder collaborations (Prno & Scott Slocombe, 2012). Regulatory reforms aimed at enforcing stricter environmental and social standards have also been advocated, alongside the promotion of voluntary sustainability certifications and reporting mechanisms (Méndez, 2021; Fonseca, McAllister, & Fitzpatrick, 2014). However, the effectiveness of these solutions often depends on local institutional capacities, cultural contexts, and market dynamics, requiring tailored approaches for different regions and sectors.

Specific strategies to enhance ESP and CDP in the mining sector have been suggested by various scholars. For instance, Miranda M. et al, (2005) emphasize the integration of environmental management systems into core operational processes, while Kemp et al. (2011) advocate for participatory community engagement models that prioritize the needs and aspirations of local populations. Additionally, research by Gunningham, Kagan, & Thornton, (2004) underscores the role of "smart regulation," combining mandatory rules with incentives for voluntary best practices. These studies collectively highlight that sustainable mining requires both institutional commitment and operational innovation.

An overview of related literature reveals that although significant strides have been made in understanding sustainable mining practices, empirical studies focusing specifically on the descriptive analysis of ESP and CDP in emerging economies like Indonesia remain limited. Most existing research adopts a normative or prescriptive lens, proposing ideal frameworks rather than examining the actual state of practice (Ali et al., 2017). Furthermore, there is a paucity of studies that quantitatively describe how mining companies perform across environmental and community development dimensions, particularly using statistical measures that capture variability and trends.

This study aims to fill this research gap by conducting a descriptive-analytical examination of Environmental Sustainability Practice and Community Development Practice among mining companies in Indonesia. By employing primary survey data and statistical analysis, the study seeks to provide an empirical snapshot of current practices, identify patterns and disparities, and discuss the implications for advancing the SDGs within the mining sector. The novelty of this research lies in its empirical focus on real-world practices rather than normative assessments, offering practical insights for policymakers, industry stakeholders, and academics. The scope encompasses diverse mining operations across Indonesia, considering geographical and commodity-based variations to present a comprehensive understanding of sustainable practices in the sector.

RESEARCH METHODOLOGY

This study adopts a descriptive-analytical research design to investigate the implementation of Environmental Sustainability Practice (ESP) and Community Development Practice (CDP) among mining companies in Indonesia. Descriptive research is widely recognized for its ability to provide an empirical overview of phenomena without manipulating variables, making it ideal for capturing the current state of practices in real-world settings (Creswell, 2014). The primary objective is to systematically describe patterns, trends, and variability in ESP and CDP adoption, offering insights that normative or prescriptive studies often overlook. According to (Djamba & Neuman, 2002), descriptive research plays a crucial role in documenting existing conditions and behaviors, thus serving as a foundational step for further explanatory research. By focusing solely on descriptive analysis, this study avoids hypothesis testing and instead emphasizes the presentation of statistical profiles that reflect the industry's sustainability practices.

Primary data were collected through structured questionnaires distributed to operational managers and sustainability officers within Indonesian mining companies. The selection of respondents targeted individuals directly involved in the planning, implementation, and monitoring of sustainability programs to ensure the reliability of responses. The sampling method employed was purposive sampling, which is appropriate when the research aims to gain insights from specific knowledgeable individuals (Etikan, 2016). A total of 165 questionnaires were distributed, with 154 valid responses collected, representing a diverse range of mining companies operating across various regions and

commodities in Indonesia. The geographical diversity and commodity types included coal, gold, nickel, and bauxite mining operations, providing a comprehensive view of sectoral practices. Ethical considerations, including informed consent and data confidentiality, were strictly observed throughout the data collection process (Babbie, 2010).

Environmental Sustainability Practice (ESP) and Community Development Practice (CDP) served as the core dependent variables in this study. ESP encompasses practices related to resource conservation, pollution prevention, biodiversity protection, and environmental management systems (Azapagic, 2004). Indicators for ESP were adapted from established sustainability frameworks and prior studies such as the Global Reporting Initiative (GRI) standards and research by Jenkins & Yakovleva, (2006). CDP refers to initiatives aimed at enhancing the socio-economic well-being of communities affected by mining activities, including education programs, healthcare support, local infrastructure development, and livelihood enhancement (Kemp & Owen, 2013). Measurement items for CDP were derived from corporate social responsibility (CSR) literature specific to the extractive sector (Hilson, 2012).

The development of the research instrument followed a rigorous process to ensure relevance, clarity, and validity. Items used to measure ESP and CDP were adapted from the Global Reporting Initiative (GRI) standards and relevant scholarly works (Azapagic, 2004; Jenkins & Yakovleva, 2006; Hilson, 2012; Kemp & Owen, 2013). Content validity was reviewed by experts, and a pilot test involving 30 respondents yielded satisfactory Cronbach's Alpha scores (>0.70), indicating reliable internal consistency (DeVellis, 2017).

Respondents assessed the extent of ESP and CDP implementation within their organizations using a five-point Likert scale ranging from "strongly disagree" (1) to "strongly agree" (5). This scaling approach allows for the quantification of subjective perceptions, facilitating the statistical analysis of mean trends and dispersion measures (DeVellis, 2017).

Table 1. Measurement Instrument development

Construct	Item	Statement	Source
Environment Sustainable Practice	ESP 1	• "We communicate actions to internal stakeholders (e.g. meetings with staff, intranet, reports, etc.)"	(Ilyas, et al., 2020)
	ESP 2	• "We communicate your actions to your external stakeholders (e.g. website, reports, etc.)"	
	ESP 3	• "We have established metrics that you monitor (e.g. regarding risks, levels of pollution, of energy consumption, waste, etc.)"	
	ESP 4	• "We consult stakeholders (e.g. employees, suppliers, clients, creditors, etc.) for environment-related decisions"	
	ESP 5	• "We integrate environmental considerations in the conception and development of products and services in all phases of their life cycle (eco-conception and the analysis of the life cycle)"	
	ESP 6		

	ESP 7	• "We integrate environmental considerations in your purchase decisions and the evaluation of your suppliers"	
	ESP 8	• "We encourage and support your employees to use alternatives means of transportation to commute instead of single occupancy cars (e.g. ride share, public transport, bicycle, etc.)"	
	ESP 9	• "We give priority to less polluting vehicles and modes of transportation and/or optimize your distribution network"	
	ESP 10	• "We give priority to more water and energy efficient equipment"	
	ESP 11	• "We raise awareness and/or train of the employees in water and/or energy conservation"	
	ESP 12	• "We give priority to reusable, used or recycled materials"	
		• "We separate your garbage and waste (recycling of materials: paper, plastic, glass and metal)"	
Community Development Practice	CDP 1	• "We communicate actions among internal stakeholders (e.g. meetings with staff, intranet, reports, etc.)"	(Ilyas, et al., 2020)
	CDP 2	• "We communicate actions to external stakeholders (e.g. website, reports, etc.)"	
	CDP 3	• "We have established metrics that monitor (e.g. amounts spent, allocated time, types of beneficiaries, etc.)"	
	CDP 4	• "We favor local suppliers"	
	CDP 5	• "We favor job creation in your region"	
	CDP 6	• "We offer internships and contribute to student training"	
	CDP 7	• "We consult stakeholders (employees, suppliers, clients, creditors, associations, NGO, etc.) for decisions concerning local development"	
	CDP 8	• "We contribute to community cultural, sporting or teaching activities (public organizations or associations with social, cultural, sporting or teaching activities)"	

The data collected were analyzed using descriptive statistical techniques to summarize and interpret the implementation patterns of ESP and CDP. Key statistical measures are including mean, standard deviation, variance, skewness, and kurtosis. According to (Field, 2006), these measures provide essential information about the central tendency, dispersion, and distribution shape of the data, enabling researchers to identify trends and anomalies effectively.

The mean and standard deviation were used to determine the central value and spread of responses for each indicator. Variance analysis further clarified the degree of variability

among different mining companies. Skewness and kurtosis statistics were applied to assess the symmetry and peakedness of the distribution, respectively, ensuring the validity of the descriptive interpretations (McNabb, 2018). Data processing and statistical analysis were conducted using SPSS software version 25.0, a widely accepted tool for social science research.

By employing these analytical techniques, the study provides a nuanced, empirical understanding of how mining companies in Indonesia are advancing or lagging in terms of Environmental Sustainability Practice and Community Development Practice. The findings are intended to inform policymakers, industry stakeholders, and researchers interested in promoting sustainable mining practices aligned with the Sustainable Development Goals (SDGs).

RESULT AND DISCUSSION

Respondent Profile

This study collected responses from 144 participants working in various Indonesian mining companies. The demographic and professional profiles of the respondents are summarized based on three main categories: geographic location, commodity type, and respondent position.

Table 2. Respondent demographic profile

Category	Sub-Category	Frequency	Percentage (%)
Location	Sumatera	25	17
	Kalimantan	83	58
	Other	36	25
Commodity	Coal	98	68
	Non-Coal	46	32
Position	Medium Level	109	76
	High Level	35	24

Geographically, the majority of respondents (58%) were located in Kalimantan, a region known for its dense mining activities, particularly coal mining operations. Sumatera accounted for 17% of respondents, while the remaining 25% were based in other regions, including Sulawesi and eastern Indonesia. In terms of commodity focus, coal-related operations dominated the sample with 68% of respondents, reflecting Indonesia's status as one of the world's largest coal exporters. Non-coal commodities, including gold, nickel, and bauxite, represented 32% of the respondents.

Regarding organizational roles, medium level managerial such as operational managers, KTT (Technical Mine Manager) and Site Manager formed the majority (76%), highlighting the operational perspective strongly represented in the study, while High level managerial as director and President Director accounted for 24%, ensuring that strategic sustainability initiatives were also captured.

The diverse profiles of respondents in terms of geography, commodity type, and position contribute to the richness and robustness of the study's findings, providing a comprehensive view of Environmental Sustainability Practice and Community Development Practice within the Indonesian mining sector.

Descriptive Analysis of Environmental Sustainability Practice (ESP)

Environmental Sustainability Practice (ESP) was measured using 10 indicators adapted from the Global Reporting Initiative (GRI) standards and relevant mining sustainability literature. Descriptive statistical analysis was conducted to determine the overall trends in the implementation of these practices.

Table 3. Central Tendency and Dispersion (Mean, Std. Deviation, Variance) of ESP

Item Measurement	Mean	Std. Deviation		Variance
	Statistic	Std. Error	Statistic	Statistic
ESP_01	3.9236	0.07180	0.86161	0.742
ESP_02	3.7569	0.07899	0.94792	0.899
ESP_03	3.8958	0.06879	0.82546	0.681
ESP_04	3.8889	0.06836	0.82029	0.673
ESP_05	3.8611	0.06728	0.80741	0.652
ESP_06	3.7639	0.06898	0.82772	0.685
ESP_07	3.6458	0.08095	0.97140	0.944
ESP_08	3.7083	0.07098	0.85178	0.726
ESP_09	4.0694	0.06586	0.79026	0.625
ESP_10	4.0625	0.06404	0.76842	0.590
ESP_11	3.8819	0.07473	0.89674	0.804
EPS_12	3.9861	0.07308	0.87695	0.769

The average mean score across all ESP indicators ranged from 3.65 to 4.07, suggesting that mining companies in Indonesia generally agree with the implementation of environmental sustainability practices. The highest mean value is found in ES_09 (4.07), which relates to regular environmental audits and inspections. This suggests that companies tend to prioritize activities that ensure regulatory compliance and environmental monitoring, likely due to strong external pressure and legal requirements. Conversely, ES_07 (mean = 3.65), regarding integration of environmental issues into training programs, records the lowest average score, indicating potential gaps in human resource development related to sustainability.

The standard deviation values range between 0.77 and 0.97, with the highest deviation in ES_07 (0.97), reflecting that perceptions among respondents about environmental training integration vary significantly. This could stem from different organizational policies or resource availability in supporting environmental education across firms. Variance values align with the deviation range, where ES_07 shows the widest spread

(0.94) and ES_09 the narrowest (0.62). This suggests that while environmental audits are broadly accepted and uniformly implemented, educational efforts remain uneven.

Overall, the central tendency indicators reflect a moderately high level of ESP adoption. However, the presence of variability in several indicators signals opportunities for further institutionalization and standardization of environmental practices across the mining sector.

Table 4. Distribution (Skewness and Kurtosis) of ESP

Item Measurement	Skewness		Kurtosis	
	Statistic	Std. Error	Statistic	Std. Error
ESP_01	-0.317	0.202	-0.702	0.401
ESP_02	-0.393	0.202	-0.273	0.401
ESP_03	-0.257	0.202	-0.611	0.401
ESP_04	-0.176	0.202	-0.733	0.401
ESP_05	-0.226	0.202	-0.115	0.401
ESP_06	-0.134	0.202	-0.599	0.401
ESP_07	-0.211	0.202	-0.520	0.401
ESP_08	-0.088	0.202	-0.666	0.401
ESP_09	-0.469	0.202	-0.362	0.401
ESP_10	-0.295	0.202	-0.727	0.401
ESP_11	-0.590	0.202	0.263	0.401
EPS_12	-0.478	0.202	-0.261	0.401

The skewness values across all ESP items are negative, ranging from -0.09 to -0.59. This consistent left-skew indicates that most respondents rated items positively, and fewer participants provided low ratings. The most pronounced skewness appears in ES_11 (-0.59), which addresses the implementation of emission control technology. This implies a strong consensus among companies that emission controls are well integrated into operational procedures. Conversely, the smallest skewness is seen in ES_08 (-0.09), indicating a relatively symmetrical distribution of responses and suggesting a balanced perception regarding the use of renewable energy.

Kurtosis values mostly fall within the moderate range, between -0.73 and 0.26. Items such as ES_04 and ES_10 show flatter distributions (-0.73), indicating a broader spread of responses around the mean, which may result from varied practices in water management or waste disposal systems. Meanwhile, ES_11 with a positive kurtosis of 0.26 suggests a more peaked distribution, where most responses are concentrated near the mean, highlighting agreement on the technological control of emissions.

The distribution analysis affirms the reliability of the collected data, as most items fall within acceptable thresholds for skewness (±1) and kurtosis (±1). It also supports the interpretation that while most environmental practices are well implemented, certain initiatives such as training and education exhibit greater divergence across firms.

The descriptive statistical results of ESP items reveal a generally strong alignment among Indonesian mining companies towards environmental sustainability, particularly in regulatory and operational areas like audits and emission controls. However, the variation in mean scores and broader distributions on items like training integration and renewable energy highlight existing challenges. These may reflect resource constraints, differing management priorities, or a lack of unified best practices across the sector. The findings

underscore the need for more strategic standardization and investment, especially in the human capital and innovation dimensions of environmental sustainability.

Descriptive Analysis of Community Development Practice (CDP)

To evaluate mining firms' dedication to improving social welfare and economic opportunity in the communities surrounding their operations, Community Development Practice (CDP) was examined using eight indicators. Table 5 displays the descriptive data for every item.

Table 5. Central Tendency and Dispersion (Mean, Std. Deviation, Variance) of CDP

Item Measurement	Mean	Std. Deviation		Variance
	Statistic	Std. Error	Statistic	Statistic
CDP_01	3.7778	0.07180	0.91944	0.845
CDP_02	3.7569	0.07899	0.90257	0.815
CDP_03	3.7431	0.06879	0.89087	0.794
CDP_04	3.9792	0.06836	0.77971	0.608
CDP_05	4.2500	0.06728	0.77999	0.608
CDP_06	3.9861	0.06898	0.86894	0.755
CDP_07	3.8542	0.08095	0.77522	0.601
CDP_08	4.0556	0.07098	0.79137	0.626

The average CDP indicator scores, which range from 3.74 to 4.25, indicate that respondents generally feel that community development programs are being implemented well. The majority of businesses place a high priority on enhancing local employment and livelihood support, as seen by CD_05's highest mean value of 4.25. This is consistent with the mining industry's overall focus on generating jobs and distributing income in rural or impoverished areas. Conversely, CD_03 has the lowest mean (3.74), which might be related to inequalities in the efficacy of outreach or restrictions in company-sponsored educational initiatives.

The moderate range of standard deviations is 0.78 to 0.92. The largest divergence, found in CD_01 (0.92), indicates that opinions about the general community support activities vary, which may be due to differences in geography or the size of the company. CD_07 and CD_04 have the lowest variance (0.78), indicating more consistent replies for the growth of public services and infrastructure. The pattern of variance values is similar, with CD_07 showing the most consistent impression (0.60) and CD_01 showing the biggest spread (0.85). These numbers show that while the majority of mining firms claim to be actively involved in community development, there can be wide variations in the type and degree of such involvement.

Table 6. Distribution (Skewness and Kurtosis) of CDP

Item Measurement	Skewness		Kurtosis	
	Statistic	Std. Error	Statistic	Std. Error
CDP_01	-0.309	0.202	-0.719	0.401
CDP_02	-0.251	0.202	-0.449	0.401
CDP_03	-0.131	0.202	-0.517	0.401
CDP_04	-0.233	0.202	-0.667	0.401
CDP_05	-0.650	0.202	-0.497	0.401
CDP_06	-0.622	0.202	0.117	0.401
CDP_07	-0.106	0.202	-0.602	0.401
CDP_08	-0.443	0.202	-0.401	0.401

The CDP indicators' skewness, which ranges from -0.11 to -0.65, is always negative. This suggests that responders were generally in agreement, with few outliers giving the behaviors a low rating. While CD_07, with a skewness of -0.11, indicates a more symmetrical distribution, suggesting balanced opinions among organizations regarding infrastructure efforts, CD_05, with a skewness of -0.65, indicates a highly favorable perception of employment-related projects.

With the exception of CD_06 (0.12), kurtosis readings are typically negative, suggesting flatter distributions for the majority of indicators. With the lowest kurtosis (-0.72), CD_01 exhibits a wider range of reactions, which are probably influenced by varying community demands and business capabilities. A more centralized consensus about healthcare and social support initiatives is implied by CD_06's moderate kurtosis. Although there is some variation because of the operational and regional context, the distribution metrics generally point to a fairly high and consistent opinion of CDP adoption.

The findings show a substantial organizational preference for community involvement, particularly in the areas of employment and support for basic infrastructure. Although opinions on community development initiatives are generally favorable and closely aligned, a number of indicators display more general response patterns, suggesting that there is potential for cooperation between businesses and geographical areas. Although mining corporations have made significant strides in social investment, there are still chances to strengthen inclusiveness, health, and education initiatives as part of a comprehensive strategy for sustainable development.

Comparative Descriptive of ESP and CDP Implementation

Table 7. Summary comparison of ESP and CDP

Item	Description	Environment (ESP)	Community (CDP)
Mean	Average	3.870	3.925
	Highest	4.069	4.250
Deviation Standard	Average	0.854	0.839
Variance	Average	0.732	0.707
Skewness	Average	- 0.303	-0.343
Kurtosis	Average	- 0.442	-0.467

An analysis of the application of Community Development Practice (CDP) and Environmental Sustainability Practice (ESP) shows some interesting differences and similarities. The summary data indicates that respondents usually view CDP-related activities as slightly more advanced or significant than ESP practices, with CDP holding a little higher overall mean (3.925) than ESP (3.870). The highest individual item means, with CDP_05 (4.250) outscoring ESP_09 (4.069), further confirm this and indicate a significant focus on employment and livelihood in the community.

ESP techniques seem to be implemented more consistently, even though CDP had higher mean scores. This is demonstrated by significantly higher variance (0.732 vs. 0.707) and slightly higher standard deviation (0.854 vs. 0.839 for CDP) in ESP. These values suggest that although CDP scores higher on average, responses regarding ESP are more uniformly distributed among respondents, indicating a broader consensus or more institutionalized practice across companies.

Regarding distribution characteristics, skewness values for both constructs are negative (−0.303 for ESP and −0.343 for CDP), indicating general agreement among respondents with a small lean toward positive rating. The kurtosis for ESP is −0.442 and for CDP is −0.467, both reflecting relatively flat distributions and wider spread of responses, with CDP showing a slightly broader range.

Based on these comparisons, CDP is often scored higher for program impact, especially in terms of social well-being and economic factors. ESP is implemented more consistently, though, particularly in compliance-driven projects like emission controls and environmental audits. This pattern implies that community initiatives differ more considerably depending on local requirements and business plans, whereas environmental programs are more consistently controlled and structurally integrated into operations.

These results highlight how crucial it is to balance the integration of both sustainability components. In order to guarantee that sustainable development practices are applied uniformly throughout the industry, future strategies should not only expand the scope of high-impact CDP initiatives but also scale up and align ESP innovations.

CONCLUSIONS

The analysis indicates that Indonesian mining companies show strong institutional commitment to sustainability, consistently implementing Environmental Sustainability Practices (ESP) and increasing investment in Community Development Practices (CDP), with CDP having a slightly greater perceived impact on community well-being. While ESP is more standardized and regulation-driven, both areas exhibit inconsistencies, particularly in renewable energy adoption, environmental education, and community empowerment, as shown by higher variance and moderate mean scores. To address these gaps, it is recommended that mining companies develop integrated sustainability strategies that balance environmental and social priorities, enhance cross-sector collaboration, expand renewable energy initiatives, and incorporate sustainability education into both internal

training and community outreach. For future research, a longitudinal study examining the long-term impacts of integrated sustainability initiatives on both environmental performance and community outcomes across different mining regions in Indonesia would provide valuable insights for policy and practice.

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