ISBN: 978-628-96613-1-6. ISSN: 2414-6390. Digital Object Identifier: https://dx.doi.org/10.18687/LACCEI2025.1.1.2195

Social and Environmental Impacts of Non-Metallic Mining in Quilcas, Peru: A Quantitative Analysis with Regression Models

Luis Ricardo Flores-Vilcapoma[1]; Augusto Aliaga-Miranda[2]; Christian Efrain Raqui-Ramirez[2]; Yuri Sánchez-Solis[2]; Wilmar Salvador Chávarry-Becerra[3]; Nilton Marx Huaroc-Ponce[4]; Angel Raúl Dueñas-Carbajal[2]

[1]Universidad Tecnológica del Perú, Perú, *C28305@utp.edu.pe*
[2]Universidad Nacional Intercultural de la Selva Central Juan Santos Atahualpa, Perú, *aaliaga@uniscjsa.edu.pe*, *craqui@uniscjsa.edu.pe*, *ysanchez@uniscjsa.edu.pe*, *aduenas@uniscjsa.edu.pe*
[3]Universidad Continental, Perú, *wchavarry@continental.edu.pe*
[4]Universidad Nacional Daniel Alcides Carrión, Perú, *nhuarocp@undac.edu.pe*

Abstract*– This study analyzes the social and environmental impacts of the non-metallic mining activity of the Calcarios Comacsa company in the Peasant Community of Quilcas, in the Junín region of Peru. An interdisciplinary approach was used, combining social and environmental perspectives to evaluate the effects of mining in a rural context. The research was based on the use of multiple regression models and correlation analysis to determine interdependencies between key variables. The methodology adopted a quantitative, cross-sectional and non-experimental design, using a sample of 70 observations obtained from surveys applied to the population of the affected community. Six main variables were analyzed: environmental quality, loss of natural resources, corporate environmental management plan, social cohesion, quality of life and compliance with social commitments. The results indicate that quality of life was the best valued variable with an average of 2.786, while environmental quality presented the lowest perception (1.886). The correlation analysis revealed strong associations between social cohesion and quality of life (0.854), as well as between the fulfillment of social commitments and quality of life (0.845). The regression model showed that social cohesion has a positive and significant effect on environmental quality (0.376, $p < 0.001$) and the loss of natural resources (0.265, $p < 0.05$), while compliance with social commitments significantly impacts corporate environmental management (0.468, $p < 0.001$). Heteroskedasticity was identified in some models, which was corrected using variance-weighted estimates, improving the precision of the estimators. In conclusion, the findings highlight the importance of strengthening social cohesion and corporate responsibility to improve the perception of mining impact and promote more sustainable development in affected communities.

***Keywords*—Environmental Impacts, Social Impacts, Mining impact, Social Cohesion, Environmental Quality**

I. Introduction

[1] point out that non-metallic mining activity contributes significantly to the country's economy, becoming an activity that generates employment and promotes development opportunities. [2] maintain that developing countries are those where its use is most important since it constitutes a fundamental axis for their economic growth. Something important to note is that this activity, by its very nature, faces important social and environmental challenges, where the ecosystems of the surrounding communities are the most directly affected [3], [4]. The purpose of this research was to analyze the activities of the non-metallic mining company Calcarios Comacsa, located in the Quilcas Peasant Community in the Junín region of Peru, with the objective of understanding its socio-environmental implications in the local context.

The study combines social and environmental approaches, in order to optimally analyze the repercussions that mining exploitations have in the circumstances of peasant communities. The study is focused according to [5] and [6] in that there are many negative antecedents on the part of many of the companies that carry out exploitation work in the field of mining, due to non-compliance with the agreed agreements, limiting themselves to complying with them only when they require an extension or a permit. These negative factors generate a lot of suspicion among community members since, in addition, today they are already aware that many times the financial resources generated, in most cases, do not compensate for the environmental deterioration caused, reaching the point of opposing the exploitation of new mining projects in most cases [7].

Likewise, [8] the analysis of this case takes on special relevance in the context of the socio-environmental conflicts in the country, which have been increasing in recent years due to the expansion of mining activity. The deficiency of adequate environmental management and the absence of solid corporate social commitment policies has led to a persistent confrontation between mining companies and the impacted communities [9]. In Quilcas, this situation intensifies due to the impression that its residents have regarding their authorities, where they do not act effectively to comply with their social and environmental regulations, leaving them vulnerable to the negative effects that mining may cause.

In this sense, the present study aims to provide objective evidence on the repercussions of non-metallic mining exploitation in a peasant community and also to provide suggestions that promote the strengthening of the link between mining companies and peasant communities. It is projected that the discoveries found in this research can contribute as a basis to the formulation of government strategies aimed at a more sustainable mining industry, which is capable of mitigating its negative repercussions and promotes equitable and participatory progress among the affected population.

II. Literary review

A. Social Impacts

[10] social impacts are the modifications in community dynamics, interpersonal relationships and quality of life of a population due to external activities, such as mining, that can generate positive or negative effects on their social well-being and development. Social impacts are measured in social cohesion, quality of life and compliance with social commitments.

B. Social Cohesion

This concept refers to the degree of integration and positive relationships that exist between the members of a community. Social cohesion is crucial for community stability and development, and can be negatively affected by extractive activities that introduce conflicts of interest or internal tensions. Previous studies have highlighted that mining can weaken traditional social networks by generating divisions between those who support and those who oppose mining operations [11].

C. Quality of Life

It is defined as the degree of physical, financial and social balance that people possess in a specific environment. In the context of mining, living conditions can be improved by the creation of jobs, however, these conditions can also deteriorate due to negative factors such as deterioration in health due to environmental alteration or reduced agricultural production [12].

D. Compliance with Social Commitments

[13] refer to the number of mining companies that manage to respect social pacts or agreements, regarding the care of the environment and/or the agreed economic compensations. The investigation indicates that the neglect of these pacts by the mining company manages to negatively impact trust with the community members or residents and this marks the starting point of social conflicts.

E. Environmental Impacts

[14] refers to the alterations in the ecosystem caused by mining activity, such as water pollution, soil degradation and the impact of flora and fauna, affecting the sustainability of natural resources in the Peasant Community of Quilcas. These are measured in environmental quality, loss of natural resources and environmental management plan.

F. Environmental Quality

[15] includes aspects related to the purity and sustainability of resources such as water, air and soil. The mining industry is characterized by causing environmental deterioration, due to the generation of waste and emissions typical of this type of activity, affecting the health of its population and causing irreparable damage to natural resources.

G. Loss of Natural Resources

[16] refers to the degradation of the ecosystem, the transformation of the landscape and the extinction of flora and fauna. Likewise, it not only manages to negatively affect the environment, but also reduces or even eliminates other types of activities such as agriculture and livestock.

H. Environmental Management Plan

[17] and [18] refer to the different actions that companies manage to implement in order to reduce environmental repercussions. A Refers to the strategies implemented by companies to mitigate the environmental impacts of their activities. A safe system must include monitoring, restoration and community engagement measures. However, in most cases, laxity in compliance or inspection restricts its effectiveness, increasing damage to the environment and affected communities.

III. Methodology

A. Sample

The study employed a quantitative, cross-sectional, and non-experimental design, utilizing a sample of 70 observations gathered through surveys administered to members of the affected community.

Table I presents the main variables analyzed in the research, organized into two categories: social impacts and environmental impacts. In the social dimension, three key components are considered. First, social cohesion, which measures the level of community integration and the perception of trust among its members, essential elements for community stability and development. Second, quality of life is examined, assessed based on health conditions and the economic well-being of the population, providing insights into the direct impact of mining activities on the daily lives of residents. Finally, the analysis includes compliance with social commitments, with an indicator reflecting the extent to which the mining company honors previously established social and environmental agreements, influencing the perception of corporate responsibility and trust.

TABLE I
MAIN VARIABLES

Variables	Dimensions	Indicators
Social Impacts	Social Cohesion	Level of community integration, perception of trust
	Quality of Life	Health conditions, economic well-being
	Compliance with Social commitments	Degree of compliance with social and environmental agreements
Environmental Impacts	Environmental Quality	Water purity, air quality, soil condition
	Loss of Natural Resources	Extent of deforestation, impact on flora and fauna
	Company Environmental Management Plan	Mitigation strategies, environmental monitoring, community participation

On the other hand, regarding environmental impacts, three fundamental dimensions are analyzed. Environmental quality is the first, focusing on aspects related to the purity of water, air, and soil quality, essential indicators for evaluating the state of the affected natural environment. Next, the analysis addresses the loss of natural resources, considering the degree of deforestation and the impact on local flora and fauna, which reflect the direct consequences of mining activities on the ecosystem. Lastly, the company's environmental management plan is assessed through mitigation strategies, environmental monitoring efforts, and mechanisms for community participation, which help evaluate the effectiveness of the measures implemented to reduce environmental impact. Together, these variables provide a comprehensive view of the social and environmental repercussions of mining in the Quilcas community.

B. *Regression models*

For the results, a multiple linear regression model and correlation analysis are used to determine the impact that exists between the dimensions, as well as their statistical significance. For this, the estimation method will be Ordinary Least Squares (OLS), since it is the method that is very important to make a consistent estimate if it meets the conventional assumptions.

$$y_i = \theta_{i,0} + \theta_{i,1}x_1 + \theta_{i,2}x_2 + \theta_{i,3}x_3 + u_i, \quad \text{for } i = EQ, LNR, CEMP \qquad (1)$$

Where

y_{EQ}: Environmental quality

y_{LNR}: Loss of natural resources

y_{CEMP}: Company environmental management plan

x_1: Social cohesion

x_2: Quality of life

x_3: Fulfillment of social commitments

u_i: Disturbance term, $u_i \sim iid(0, \sigma^2)$

The formula shows the estimation by Ordinary Least Squares (OLS) and Weighted Least Squares (WLS), which consists of minimizing the Sum of Squared Residuals (SSR) to obtain consistent estimates.

$$\begin{cases} SSR = \min_{\theta_i}(y_i^T - \theta_i^T X^T)(y_i - X\theta_i) & \text{Homoscedasticity} \\ SSR = \min_{\theta_i}(y_i^T - \theta_i^T X^T)D(y_i - X\theta_i) & \text{Heteroskedasticity} \end{cases} \qquad (2)$$

Where $\theta_i = [\theta_{i,0}, \theta_{i,1}, \theta_{i,2}, \theta_{i,3}]^T$ represents the vector of coefficients, and $X = [1, x_1, x_2, x_3]^T$ denotes the vector of explanatory variables. The matrix D is a diagonal matrix whose diagonal elements are given by the components of w, with of $w = \{v/1^T v\}(1^T 1)$, where v is the original column vector of user-specified weights. The vector w thus represents the normalized weights employed in the weighted least squares estimation process.

$$\begin{cases} \theta_i = (X^T X)^{-1} X^T y_i & \text{Homoscedasticity} \\ \theta_i = (X^T D X)^{-1} X^T D y_i & \text{Heteroskedasticity} \end{cases} \qquad (3)$$

This methodological approach ensures a rigorous and reliable analysis, facilitating a deeper understanding of the relationships between the dimensions and their influence within social impact of the community.

IV. RESULTS

A. *Descriptive statistics*

TABLE II
DESCRIPTIVE STATISTICS

Stats	EQ	LNR	CEMP	Social cohesion	Quality of life	Fulfillment of social commitments
N	70	70	70	70	70	70
Max	4.000	4.333	4.667	4.667	5.000	4.667
Min	1.000	1.000	1.000	1.000	1.000	1.000
Mean	1.886	1.990	2.071	2.205	2.786	2.576
SD	0.824	0.836	0.968	1.016	1.360	1.071
Variance	0.679	0.699	0.937	1.032	1.849	1.146
P_{50}	1.667	1.667	2.000	2.000	2.500	2.333
Skewness	0.712	0.788	0.855	0.482	0.378	0.388
Kurtosis	2.536	2.864	3.072	2.061	1.684	2.043

Table II presents the descriptive statistics of six key dimension related to the perception of social and environmental impacts of mining activity in the Quilcas Peasant Community. The results show that Quality of life is the highest-rated variable, with a mean of 2.786 and a median of 2.500, indicating a relatively positive perception compared to other evaluated dimensions. On the other hand, EQ records the lowest mean (1.886), reflecting an unfavourable perception regarding the natural environment. Standard deviations range from 0.824 to 1.360, revealing greater dispersion in responses related to quality of life, suggesting significant differences in respondents' perceptions. The presence of positive skewness values across all variables indicates a right-skewed distribution, implying that a considerable proportion of respondents hold less favourable perceptions regarding the analyzed aspects.

In terms of dispersion and distribution shape, the variables CEMP and LNR show kurtosis values greater than 3 (3.072 and 2.864, respectively), suggesting a high concentration of responses around the mean, whereas quality of life exhibits a more dispersed distribution with a kurtosis of 1.684. These findings indicate that perceptions of the company's environmental management are polarized, while quality of life is assessed with greater variability. Overall, these results highlight the need to implement more effective environmental management strategies and strengthen social cohesion to improve the general perception of mining impacts, addressing community concerns in a more equitable and sustainable manner.

B. *Statistical analysis*

TABLE III
CORRELATION MATRIX

	EQ	LNR	CEMP	Social cohesion	Quality of life	Fulfillment of social commitments
EQ	1.000	-	-	-	-	-
LNR	0.763	1.000	-	-	-	-
CEMP	0.513	0.558	1.000	-	-	-
Social cohesion	0.777	0.790	0.675	1.000	-	-
Quality of life	0.750	0.794	0.697	0.854	1.000	-
Fulfillment of social commitments	0.718	0.766	0.743	0.851	0.845	1.000

Table III presents the correlation coefficients among six key dimensions. The results reveal strong positive correlations across all variables, indicating interdependencies between environmental and social dimensions. The highest correlation is observed between social cohesion and quality of life (0.854), suggesting that improvements in social cohesion are closely linked to an enhanced perception of quality of life within the community. Similarly, the fulfillment of social commitments shows a strong correlation with quality of life (0.845), implying that adherence to corporate social responsibility agreements plays a critical role in shaping the well-being of community members. Additionally, EQ exhibits a significant correlation with LNR (0.763), highlighting the interconnected nature of environmental degradation and resource depletion.

Moreover, the CEMP demonstrates moderate to strong correlations with other variables, particularly with the fulfillment of social commitments (0.743) and social cohesion (0.675). This suggests that effective environmental management strategies contribute not only to environmental sustainability but also to social stability and trust within the community. The relatively lower correlation between EQ and the CEMP (0.513) indicates potential gaps in the company's initiatives to translate environmental policies into perceived improvements in environmental conditions. Overall, these findings emphasize the necessity for an integrated approach that simultaneously addresses environmental and social concerns to foster sustainable development and community resilience.

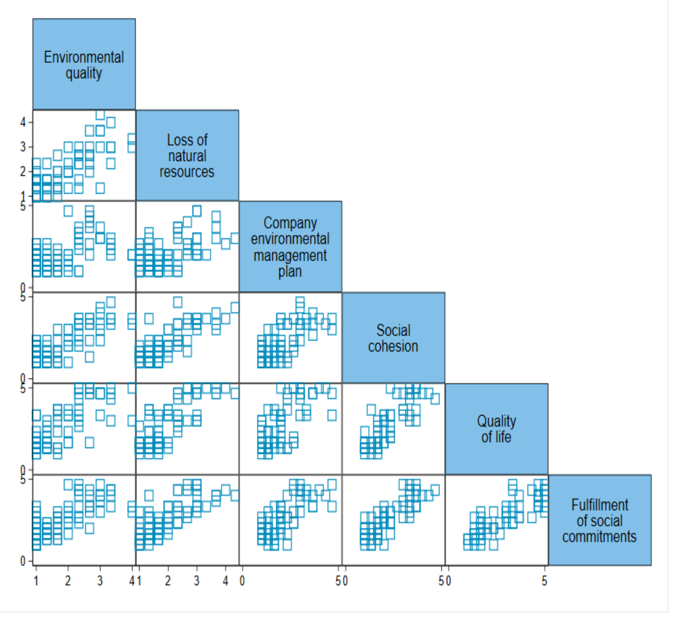

Fig. 1 Scatterplot matrix

Figure 1 presents a scatterplot matrix illustrating the relationships between six key dimensions. The scatterplots reveal a generally positive association between variables, with clear clustering patterns that suggest strong correlations, particularly between social cohesion, quality of life, and fulfillment of social commitments, reinforcing the interconnected nature of social well-being and corporate responsibility. The observed linear trends in these relationships indicate that improvements in one dimension, such as social cohesion, are likely to contribute to better perceptions of quality of life and corporate compliance. Similarly, a strong relationship is evident between EQ and LNR, demonstrating that as environmental conditions deteriorate, resource depletion becomes more pronounced.

However, some dispersion in the data suggests variability in perceptions, highlighting potential heterogeneity within the community regarding the perceived effectiveness of environmental management plans. Overall, the scatterplot matrix provides visual evidence of the intricate links between social and environmental factors, underscoring the need for integrated strategies to address both aspects comprehensively.

C. Modelling

Considering the data previously obtained, and according to the objectives proposed, multiple regression models will be carried out where the impact between the dimensions of variables and their significance will be determined.

TABLE IV
OLS RESULTS

	(1) EQ	(2a) LNR	(2b) LNR	(3) CEMP
Social cohesion	0.376*** (2.86)	0.265* (2.14)	0.283*** (13.48)	0.0429 (0.26)
Quality of life	0.170 (1.76)	0.224* (2.46)	0.217*** (15.73)	0.157 (1.28)
Fulfillment of social commitments	0.0673 (0.55)	0.144 (1.26)	0.133*** (1.26)	0.468*** (3.04)
Constant	0.411 (2.56)	0.413** (2.73)	0.418*** (16.67)	0.333 (1.63)
F statistic (3,66)	37.85	47.65		29.06
Adjusted R-squared	0.616	0.670		0.550
χ^2(66)			9643.15	
Goodness of fit			67.78	

t statistics in parentheses * p<0.05, ** p<0.01, *** p<0.001. Equation (2b) was estimated using variance-weighted least squares to correct for heteroscedasticity.

Table IV presents the results of the OLS regression models, analyzing the relationship between social and environmental variables in the context of mining activities. The findings indicate that social cohesion has a positive and statistically significant effect on EQ ($\theta_{EQ,1}$ = 0.376, p < 0.001) and loss of natural resources ($\theta_{LNR,1}$ = 0.265, p < 0.05), suggesting that a higher level of community cohesion is associated with better perceptions of the natural environment. In the heteroscedasticity-corrected model, this effect strengthens ($\theta_{LNR,1}$ = 0.283, p < 0.001), demonstrating a more robust relationship between social cohesion and perceptions of resource depletion. However, social cohesion does not show a significant influence on the CEMP ($\theta_{CEMP,1}$ = 0.0429, p > 0.05), indicating that corporate environmental policies are not directly dependent on the community's social fabric.

Regarding quality of life, a significant positive impact is observed on LNR, both in the original model ($\theta_{LNR,2}$ = 0.224, p < 0.05) and in the corrected model ($\theta_{LNR,2}$ = 0.217, p < 0.001), indicating that a better quality of life is associated with a lower perception of environmental degradation. However, its influence on EQ ($\theta_{EQ,2}$ = 0.170, p > 0.05) and the CEMP ($\theta_{CEMP,2}$ = 0.157, p > 0.05) is not significant, suggesting that perceptions of the natural environment are not solely dependent on individual well-being but rather on broader factors such as environmental policies and corporate strategies. On the other hand, the fulfillment of social commitments by the company shows a strong and highly significant positive impact on the CEMP ($\theta_{CEMP,3}$ = 0.468, p < 0.001), underscoring the importance of corporate responsibility in implementing sustainable practices.

The adjusted R-squared values, ranging from 0.550 to 0.670, indicate that the models explain between 55% and 67% of the variability in the dependent variables, suggesting a moderate-to-high explanatory capacity of the analyzed factors. The goodness-of-fit test and χ^2 values reflect an adequate model specification. The statistical significance observed in the coefficients reinforces the robustness of the findings, while the heteroscedasticity correction improves the precision of the estimators in the LNR model. Overall, these results highlight the interdependence between social and environmental dimensions, emphasizing the need for integrated strategies that strengthen both community cohesion and corporate compliance to enhance environmental perceptions in communities affected by mining activities.

TABLE V
MODEL SPECIFICATION BY REGRESSION MODELS P-VALUES

	Heteroscedasticity	Autocorrelation		Normality	Identification
Test	White test	Durbin-Watson	Breusch-Godfrey	Jarque-Bera	Ramsey RESET
Model 1	0.3619	1.7295	0.3115	0.0041	0.1856
Model 2	0.0069	1.9515	0.8912	0.6718	0.5739
Model 3	0.1676	2.1285	0.7593	0.1514	0.0151

Table 5 presents the results of various diagnostic tests applied to assess the validity and robustness of the Ordinary Least Squares (OLS) regression models. The White test results indicate that heteroscedasticity is not present in Model 1 (p = 0.3619) and Model 3 (p = 0.1676), as their p-values exceed the conventional threshold of 0.05. However, Model 2 (p = 0.0069) suggests the presence of heteroscedasticity, implying that variance is not constant across observations, which could lead to inefficient estimates. The Durbin-Watson test values, which assess autocorrelation in the residuals, show values close to the benchmark of 2 for all models, indicating no strong evidence of autocorrelation. Similarly, the Breusch-Godfrey test, with p-values above 0.05 in all models, confirms that autocorrelation is not a significant issue in any of the cases.

Regarding normality, the Jarque-Bera test indicates a significant deviation from normality in Model 1 (p = 0.0041), suggesting that the residuals are not normally distributed, which may affect inference reliability. Conversely, Models 2 ($p = 0.6718$) and 3 ($p = 0.1514$) show non-significant p-values, supporting the assumption of normally distributed residuals. The Ramsey RESET test, which evaluates model specification and potential omitted variable bias, reveals that Model 1 ($p = 0.1856$) and Model 2 ($p = 0.5739$) do not exhibit significant misspecification issues. However, Model 3 ($p = 0.0151$) suggests potential model misspecification, indicating the need for further refinement or inclusion of additional explanatory variables. These findings confirm the need to adopt corrective measures, such as the use of variance-weighted least squares in Model 2 and the reconsideration of measures of model specification in Model 3 to improve the reliability of the regression estimates.

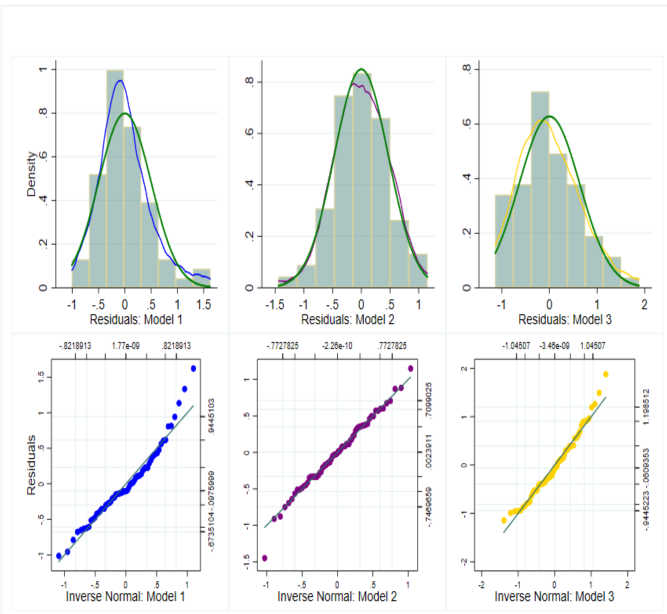

Fig. 2 Estimated kernel density and Q-Q plots. The normal distribution is represented by the green line. Grid lines are 5, 10, 25, 50, 75, 90, and 95 percentiles.

Figure 2 presents the kernel density estimation and Q-Q plots for the residuals of the three regression models, providing a visual assessment of the normality assumption. The density plots compare the empirical distribution of residuals (histograms) against the normal distribution, represented by the green line. In Model 1, the residuals exhibit noticeable deviations from normality, as evidenced by the mismatch between the empirical and normal density curves, particularly in the tails. This observation aligns with the results of the Jarque-Bera test in Table 5, which indicated a significant deviation from normality for Model 1. In contrast, the residuals for Models 2 and 3 appear to follow the normal distribution more closely, with better alignment between the estimated and theoretical curves, suggesting that the normality assumption is more plausible in these cases.

The Q-Q plots further illustrate the degree of normality in residuals by comparing their quantiles to those of a normal distribution. In Model 1, the plot shows significant deviations from the diagonal line, particularly in the tails, indicating skewness and kurtosis issues that could impact inference reliability. For Model 2, the points lie closer to the diagonal line, suggesting a better fit to the normal distribution, with only minor deviations observed at the extremes. Model 3 demonstrates an even stronger adherence to normality, as evidenced by the alignment of the data points with the diagonal line. These visual analyses reinforce the conclusions drawn from the statistical tests, highlighting potential concerns in Model 1 that may require transformation or robust estimation techniques, while confirming the suitability of Models 2 and 3 for reliable statistical inference.

V. CONCLUSIONS

The findings of this study highlight the complex interplay between social and environmental factors in the context of mining activities, emphasizing the significant role of social cohesion, quality of life, and corporate social commitments in shaping perceptions of environmental quality and resource depletion. The regression analysis confirms that social cohesion positively influences environmental quality and resource conservation, underscoring the importance of fostering strong community ties to mitigate adverse environmental impacts. Similarly, quality of life is shown to have a significant effect on resource depletion, indicating that improving well-being within the community can contribute to a more sustainable relationship with natural resources. The strong impact of corporate social commitments on the environmental management plan demonstrates the necessity for mining companies to uphold their social responsibilities and actively engage with local communities to enhance their environmental strategies.

The presence of heteroscedasticity identified in the initial Model 2 highlights the need for corrective measures to ensure the reliability of the estimates. The application of variance-weighted least squares in Model 2b successfully mitigated this problem, resulting in more robust and consistent parameter estimates, in particular strengthening the influence of social cohesion ($\theta_{LNR},1 = 0.283$, $p < 0.001$) and quality of life ($\theta_{LNR},2 = 0.217$, $p < 0.001$) on resource conservation. These adjustments confirm that addressing statistical assumptions is crucial to deriving valid conclusions and informing evidence-based policy interventions. The improved fit and increased explanatory power of the corrected model underscore the importance of adopting rigorous econometric techniques to better understand the dynamics between community well-being and environmental sustainability, ultimately guiding corporate and government strategies toward more effective and equitable resource management.

Based on the results obtained, it is recommended to implement public policies aimed at strengthening social cohesion in mining communities through active citizen participation programs, community monitoring of mining practices, and more effective conflict resolution mechanisms. Furthermore, it is proposed that authorities design regulatory frameworks that require mining companies to integrate environmental and social management plans co-designed with the affected communities, incorporating verifiable compliance indicators. Specific strategies such as independent socio-environmental audits, shared benefit agreements, and the strengthening of local capacities for environmental monitoring could improve perceptions of environmental quality and the fulfillment of social commitments. These mechanisms would not only help mitigate the identified negative impacts but also consolidate a more sustainable and equitable mining industry, reinforcing trust among companies, communities, and the State.

REFERENCES

[1] L. G. L. M. Edirisinghe, A. de Alwis, and M. Wijayasundara, “Uncovering the recycling potential of industrial waste in Sri Lanka,” *Waste Management & Research: The Journal for a Sustainable Circular Economy*, vol. 43, no. 2, pp. 254–266, Feb. 2025, doi: 10.1177/0734242X241237092.

[2] X. Wei, W. Su, and C. Du, “Evaluation of relationship between nonmetallic mineral resources production and sustainable development,” *Resources Policy*, vol. 88, p. 104428, Jan. 2024, doi: 10.1016/j.resourpol.2023.104428.

[3] M. Pouresmaieli, M. Ataei, A. Nouri Qarahasanlou, and A. Barabadi, “Building ecological literacy in mining communities: A sustainable development perspective,” *Case Studies in Chemical and Environmental Engineering*, vol. 9, p. 100554, Jun. 2024, doi: 10.1016/j.cscee.2023.100554.

[4] K. J. Bansah, P. J. Acquah, and A. Boafo, “Land, water, and forest degradation in artisanal and small-scale mining: Implications for environmental sustainability and community wellbeing,” *Resources Policy*, vol. 90, p. 104795, Mar. 2024, doi: 10.1016/j.resourpol.2024.104795.

[5] M. A. Nogueira, L. C. Costa, D. M. Resende, V. R. Carvalho, J. C. Mendes, and R. A. F. Peixoto, “Mitigating the socioeconomic impacts of the mining industry through <scp>Social Technologies</scp>: Guidelines for technology transfer between universities and communities,” *Corp Soc Responsib Environ Manag*, vol. 31, no. 1, pp. 54–68, Jan. 2024, doi: 10.1002/csr.2593.

[6] C. Saenz, “Corporate social responsibility strategies beyond the sphere of influence: Cases from the Peruvian mining industry,” *Resources Policy*, vol. 80, p. 103187, Jan. 2023, doi: 10.1016/j.resourpol.2022.103187.

[7] N. P. Hariram, K. B. Mekha, V. Suganthan, and K. Sudhakar, “Sustainalism: An Integrated Socio-Economic-Environmental Model to Address Sustainable Development and Sustainability,” *Sustainability*, vol. 15, no. 13, p. 10682, Jul. 2023, doi: 10.3390/su151310682.

[8] J. Salem, Y. Amonkar, N. Maennling, U. Lall, L. Bonnafous, and K. Thakkar, “An analysis of Peru: Is water driving mining conflicts?,” *Resources Policy*, vol. 74, p. 101270, Dec. 2021, doi: 10.1016/j.resourpol.2018.09.010.

[9] C. H. Oh, J. Shin, and S. S. H. Ho, “Conflicts between mining companies and communities: Institutional environments and conflict resolution approaches,” *Business Ethics, the Environment & Responsibility*, vol. 32, no. 2, pp. 638–656, Apr. 2023, doi: 10.1111/beer.12522.

[10] C. Wang and X. Li, “Optimizing the utilization of mineral assets and human resources for enhanced social welfare and sustainable development,” *Resources Policy*, vol. 90, p. 104755, Mar. 2024, doi: 10.1016/j.resourpol.2024.104755.

[11] P. Ghisellini, A. Ncube, M. Casazza, and R. Passaro, “Toward circular and socially just urban mining in global societies and cities: Present state and future perspectives,” *Frontiers in Sustainable Cities*, vol. 4, Sep. 2022, doi: 10.3389/frsc.2022.930061.

[12] M. Atienza, D. Fleming-Muñoz, and P. Aroca, “Territorial development and mining. Insights and challenges from the Chilean case,” *Resources Policy*, vol. 70, p. 101812, Mar. 2021, doi: 10.1016/j.resourpol.2020.101812.

[13] M. Mardonova and Y.-S. Han, “Environmental, hydrological, and social impacts of coal and nonmetal minerals mining operations,” *J Environ Manage*, vol. 332, p. 117387, Apr. 2023, doi: 10.1016/j.jenvman.2023.117387.

[14] N. Li *et al.*, “Evaluation and quantitative characterization for the ecological environment impact of open pit mining on vegetation destruction from landsat time series: A case study of Wulishan limestone mine,” *Ecol Indic*, vol. 158, p. 111371, Jan. 2024, doi: 10.1016/j.ecolind.2023.111371.

[15] S. Damseth *et al.*, “Assessing the impacts of river bed mining on aquatic ecosystems: A critical review of effects on water quality and biodiversity,” *HydroResearch*, vol. 7, pp. 122–130, 2024, doi: 10.1016/j.hydres.2024.01.004.

[16] K. Lessmeier, “Managing Mining: New Environmental Contracts In Light Of Loss, Inequality, and Climate Change,” in *Demanding a Radical Constitution*, Cham: Springer Nature Switzerland, 2025, pp. 95–111. doi: 10.1007/978-3-031-75690-0_6.

[17] P. Saik, O. Dreshpak, V. Ishkov, O. Cherniaiev, and O. Anisimov, “Change in the qualitative composition of non-metallic mineral raw materials as a result of blasting operations,” *Mining of Mineral Deposits*, vol. 18, no. 3, pp. 114–125, Sep. 2024, doi: 10.33271/mining18.03.114.

[18] yuling zhao, jinzhong yang, licong song, and weiling yao, “Distribution and existing problems of open-pit mining land in China,” in *International Conference on Remote Sensing, Surveying, and Mapping (RSSM 2024)*, Y. Zhao, Ed., SPIE, Jun. 2024, p. 31. doi: 10.1117/12.3032129.