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ANALYSIS OF ENVIRONMENTAL IMPACT MANAGEMENT ON C QUARRY MINING IN TIRON VILLAGE, BANYAKAN DISTRICT

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Abstract:
This research aims to analyze the environmental impacts of C quarry mining in Tiron Village, Banyakan District, and propose appropriate measures for environmental management. The study uses a quantitative approach with a descriptive method. The quantitative approach is employed to test hypotheses using numerical data, while the descriptive method is used to describe and analyze the collected data. The population of this research includes all stakeholders involved in C quarry mining in Tiron Village, Banyakan District. The sample is determined using purposive sampling, selecting respondents with relevant knowledge and experience related to the research. The research instrument used is a questionnaire to measure respondents' perceptions of the impacts of C quarry mining. The validity and reliability of the questionnaire are tested using Pearson correlation and Cronbach's alpha reliability tests, respectively. Data collection is done by distributing questionnaires directly to the respondents. The collected data are analyzed using statistical tests. The findings of this research will provide valuable insights into the environmental impacts of C quarry mining in Tiron Village, Banyakan District. The results will contribute to developing effective environmental management strategies to mitigate the adverse effects of mining activities. This research highlights the importance of sustainable mining practices and the need for collaboration between various stakeholders to protect the environment and ensure the continuity of development projects.

Keywords: Environmental Impact Management, C Quarry Mining, Banyakan District

INTRODUCTION

The impacts caused by quarrying activities are increasing in line with rapid development. The demand for quality and large quantities of primary materials is rising alongside the needs of construction projects. Quarrying is the initial stage in the development process of a project, where materials such as soil, limestone, sand, and crushed stone are obtained (Sudarma, 2014). Although this mining activity is crucial to supporting development, it must be addressed that it also impacts the surrounding communities and the environment. Therefore, efforts from various parties are needed to preserve the natural environment and prevent damage that could hinder development (Brenya et al., 2023). This involves cooperation between the government, mining companies, local communities, and other relevant parties (McDonald & Young, 2012).

Quarrying, such as for limestone, sand, and clay, is an extractive activity that can benefit a region economically. However, this activity also has the potential to generate negative impacts on the environment if not properly managed (Binod et al., 2021). One example is the Banyakan District, where C quarrying has been quite intensive (Romadhon & Nabilah, 2021). Analyzing the environmental impact management of C quarrying in the Banyakan District becomes crucial in this context. This analysis aims to understand the impacts generated by C quarrying activities and evaluate the efforts made to address these impacts.

The largest C quarry in the Kediri region is located in the Banyakan district, precisely in the village of Tiron (Krisnadi et al., 2020). The village, rich in resources due to its location on the slopes of Mount Wilis, experiences drought despite the rainy season. In addition, the surrounding residents also feel air pollution and road damage caused by the traffic of material-carrying trucks. These incidents are among the environmental impacts of C quarrying activities in the area (Romadhon & Nabilah, 2021).

This analysis will explore various aspects related to environmental impact management, such as air quality, water quality, land degradation, and impacts on the local ecosystem. Additionally, stakeholders, such as local government, mining companies, and the local community, will focus on reducing and addressing these negative impacts.

This analysis will provide a comprehensive overview of the environmental impact management conditions related to C quarrying in the Banyakan district. The results serve as a basis for identifying existing environmental impact management shortcomings and formulating recommendations for future improvements.

METHODS

This research uses a quantitative approach with descriptive methods. A quantitative approach is used to test hypotheses using numerical data. Descriptive methods are used to describe and analyze the collected data. The population of this research includes all parties related to excavation C in Tiron village, Banyakan District. The sample for this research was determined using purposive sampling, a sampling technique that involves selecting respondents who have knowledge and experience relevant to the research.

The research instrument used was a questionnaire. A questionnaire was prepared to measure respondents' perceptions of the impact of excavation C. The questionnaire was tested for validity and reliability before use. The validity of the instrument was tested using the Pearson correlation test. The reliability of the instrument was tested using Cronbach's alpha test. A Cronbach's alpha value > 0.6 indicates that the research instrument is reliable (Amanda et al., 2019). Data was collected by distributing questionnaires to respondents. Questionnaires were distributed directly to respondents. The data were analyzed using statistical tests. The statistical tests used are:

a) Kruskal-Wallis H tests differences in respondents' perceptions based on job category. The p-value <0.05 indicates significant differences in perception between job categories.
b) Mann-Whitney U-test to identify pairs of job categories with significant perception differences.
c) Process Hierarchy Analysis (AHP) to determine the priority of excavation impacts.

This research was conducted with due regard to research ethics. Researchers will maintain the confidentiality of respondent data and use the data only for research purposes.

RESULT AND DISCUSSION

Tiron Village Profile, Banyakan District, Kediri Regency, East Java. Banyakan Village borders this village to the north, Ngasem Village to the east, Selopanggung Village to the south, and Pelem Village to the west. In terms of demographics, the population of Desa Tiron in 2023 was 4,762 people. Its population density reached 1,023 people per square kilometer, with a total area of 4.66 square kilometers. The male population is 2,401, while the female population is 2,361.

The government of Desa Tiron is led by a village head, currently held by Sutrisno. The village head's term of office lasts from 2023 to 2027. Village officials assist the village head in carrying out governmental tasks. In the economic sector, the main livelihood of the people of Desa Tiron is farming. The main agricultural products produced are rice, corn, and sugarcane. In addition to farming, some residents work in the livestock, trade, and service sectors.

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Desa Tiron has several attractive tourism potentials, such as Bukit Dhoho Indah (BDI), Irenggolo Waterfall, and Maria Lourdes Cave. This village's potential includes agriculture, livestock, tourism, and small-scale industrial sectors. However, Desa Tiron also faces land use changes, environmental pollution, and poverty. These challenges are the focus of efforts for the future development and improvement of the village.

Source: Google Maps (2024)

Figure 1. Tiron Village Profile, Banyakan District, Kediri Regency, East Java

The research data were obtained from observations and reference studies related to the research topic. Six experts and 30 general respondents were obtained using purposive sampling techniques. The initial data analysis began by collecting the impacts of C quarrying activities in Tiron village, Banyakan district. Then, the data were validated by experts with experience and direct involvement in field activities using an expert questionnaire instrument. The results of the expert questionnaire are as follows:

Table 1. Impact of Excavation Activities C

X	Impact	X	Impact
X1	Landslides	X8	Reduced agricultural land
X2	Damage to road infrastructure	X9	Decreased availability of groundwater
X3	Air pollution occurs	X10	Changes in land surface (pits)
X4	Flood	X12	Frequent accidents on transportation routes
X5	Loss of rural atmosphere	X12	Loss of fertile soil layers
X6	A decrease in wildlife	X13	Disturbance of health among residents in the vicinity
X7	The occurrence of disputes in the village environment	X14	Contamination of groundwater

Source: Data Processed 2023

The non-parametric test used in this study is the independent K-sample test, or Kruskal-Wallis H test, to examine the effect of occupation types on respondents' answers. If the Asymp.If the sig value is >0.05, it can be concluded that there is no difference in perception among respondents. The results of the Kruskal-Wallis H test using IBM SPSS V.24 software are as follows:

Table 2. Results of the test of the influence of occupation on respondents' answers

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Test Statistics[a,b]	
	Perception
Kruskal-Wallis H	10.607
df	5
Asymp. Sig.	.060
a. Kruskal Walls Test	
b. Grouping Variable: position	

Source: Data Processed 2023

The output calculation using IBM SPSS V.24 shows an Asymp. A sig of 0.06 > 0.05 is accepted, indicating no difference in respondents' perceptions based on their occupations. This suggests that, from the analysis conducted, there is no statistically significant difference in the responses given by respondents from various occupations. In other words, in the context of this study, respondents' occupations do not significantly influence their responses to the questionnaire questions.

The validity test was conducted by comparing the calculated correlation coefficient (r) with the critical value of r or examining the significance (Sig. 2-tailed). Suppose the calculated r-value is greater than the critical r-value. In that case, it is considered valid, or if the significance value is less than 0.05, it is considered valid, and vice versa. The validity test results using IBM SPSS V.24 indicate that the overall questionnaire results are valid because the significance value is less than 0.05.

Reliability testing is done by examining the Cronbach's alpha coefficient value. The questionnaire is reliable if Cronbach's alpha coefficient value is > 0.6. The reliability testing results using IBM SPSS V.24 found that the questionnaire is reliable because Cronbach's alpha value is > 0.6, and further analysis can be conducted.

Analytical Hierarchy Process (AHP). This analysis begins with pairwise comparison matrices to determine the weights of elements, followed by consistency testing of the matrices and impact categorization. The comparison of the magnitude of impact and the frequency of occurrence can be seen in the following table:

Table 3. Pairwise Comparison Matrix

	Very High	High	Medium	Low	Very Low
Very High	1,00	2,00	3,00	4,00	5,00
High	0,50	1,00	2,00	3,00	4,00
Medium	0,33	0,50	1,00	2,00	3,00
Low	0,25	0,33	0,50	1,00	2,00
Very Low	0,20	0,25	0,33	0,50	1,00
Total	**2,28**	**4,08**	**6,83**	**10,50**	**15,00**

Source: Data Processed 2023

From the pairwise comparison matrix above, the calculation of element weights is continued by dividing the sum of elements by the value of each element, as shown in the following table.

Table 4. Calculation of Element Weights

	Very High	High	Medium	Low	Very Low	Total	Average	Percentage
Very High	0,438	0,490	0,439	0,381	0,333	2,081	0,416	100,00%
High	0,219	0,245	0,293	0,286	0,267	1,309	0,262	62,90%

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Medium	0,146	0,122	0,146	0,190	0,200	0,805	0,161	38,69%
Low	0,109	0,082	0,073	0,095	0,133	0,493	0,099	23,68%
Very Low	0,088	0,061	0,049	0,048	0,067	0,312	0,062	14,99%
Total	1,000	1,000	1,000	1,000	1,000	5,000		

Source: Data Processed 2023

The calculation results indicate that the very high impact has the most significant influence compared to other impacts. This suggests that factors categorized as "very high" should be prioritized in decision-making and impact mitigation efforts.

Table 5. Element Weights

	Very Low	Low	Medium	High	Very High
Weight	0,150	0,237	0,387	0,629	1,000

Source: Data Processed 2023

The weight values help determine the priority and urgency of addressing the impacts of mining activities. Impacts with high weights (high and high) must be the main focus, while impacts with low weights (medium, low, and very low) can be addressed gradually.

The following analysis tests the consistency of the matrix by examining the maximum eigenvalue (λ max), which should approximate the number of elements (n), and the remainder of the eigenvalue should approach zero. Consistency calculation is performed by multiplying the average of the elements with the original matrix, resulting in the maximum λ value as follows:

Table 6. Consistency Matrix Test

1,00	2,00		3,00	4,00	5,00		0,416		2,129	/	0,416	=	5,115
0,50	1,00		2,00	3,00	4,00		0,262		1,337	/	0,262	=	5,108
0,33		0,50	1,00	2,00	3,00	X	0,161	=	0,815	/	0,161	=	5,060
0,25	0,33		0,50	1,00	2,00		0,099		0,495	/	0,099	=	5,023
0,20	0,25		0,33	0,50	1,00		0,062		0,314	/	0,062	=	5,035
											Total	=	25,342
											n = 5, Thus λ_{maks}	=	5,068

From the calculation of the consistency matrix test, the maximum eigenvalue (λ max) value obtained is 5.068; this value is close to the number of elements, which is 5, and the remainder of the eigenvalue is 0.068, which means it is close to zero, thus indicating that the matrix is consistent. Then, to test the consistency of hierarchy and accuracy, with the number of elements being 5, the Consistency Ratio Index (CRI) value is 1.12.

$$\textit{Consistency Index}\ (CI) = (\lambda_{maks} - n) / (n-1)$$

$$\textit{Consistency Ratio}\ (CR) = CI / CRI < 10\%$$

From the calculation, the consistency index is obtained as 0.017, and the consistency ratio is 0.015 < 10%, indicating that the hierarchy is consistent and highly accurate. The following calculation involves computing the average between the frequency and magnitude of the impact by multiplying each weight of the frequency and magnitude of the impact with the total number of frequency and

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magnitude elements from the questionnaire results, then dividing by the number of variables (X). The results of this multiplication are then analyzed for their factor values using the equation:
F = L + I – (L x I).
F: Factor Value (on a scale of 0-1)
L: Frequency
I: Impact Magnitude.

The result of the factor value calculation is as follows:

Table 7. Standard Impact Categories

X	The impacts observed	Average Frequency Value	Average Magnitude of Impact Value	Factor Value (F)
X1	Landslides	0,317	0,447	0,623
X2	Damage to road infrastructure	0,371	0,699	0,810
X3	Occurrence of air pollution (dust and smoke)	0,476	0,544	0,761
X4	Flooding	0,370	0,418	0,634
X5	Loss of rural ambiance	0,284	0,641	0,743
X6	Decrease in wildlife population	0,182	0,387	0,499
X7	Environmental disputes within the village	0,145	0,206	0,321
X8	Reduction of agricultural land	0,337	0,481	0,656
X9	Decrease in groundwater availability	0,287	0,505	0,647
X10	Changes in land surface (holes)	0,365	0,410	0,625
X11	Frequent accidents along transportation routes	0,318	0,308	0,528
X12	Loss of fertile soil layers	0,220	0,313	0,464
X13	Disturbances in the health of surrounding residents	0,350	0,473	0,657
X14	Contamination of groundwater	0,180	0,209	0,351

Source: Data Processed 2023

The factor values serve as guiding lights, illuminating the path toward prioritizing mitigation efforts and policy-making concerning the impacts of quarrying activity. Impacts with high factor values demand immediate attention, while those with lower factor values can be addressed gradually. Building upon the calculations, we analyze the impact categories by categorizing the observed impacts into groups based on the factor above values. Below is the standard table for impact categories:

Table 8. Standard Impact Categories

Factor Value	Category	Mitigation Steps
0,7 - 1,0	High	Impact reduction must be carried out.
0,4 - 0,7	Medium	Improvement steps are necessary under specific conditions.
0,0 - 0,4	Low	Improvement steps, if deemed necessary

Source: SNI 8615 (2018)

Based on the table above, impacts in low, moderate, and high categories can be obtained as follows:

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Table 9. Impact Categorization

X	Risk Factor	Factor Value	Category
X2	Damage to road infrastructure	0,810	High
X3	Occurrence of air pollution (dust and smoke)	0,761	High
X5	Loss of rural ambiance	0,743	High
X13	Disturbances in the health of surrounding residents	0,657	Medium
X8	Reduction of agricultural land	0,656	Medium
X9	Decrease in groundwater availability	0,647	Medium
X4	Flooding	0,634	Medium
X10	Changes in land surface (holes)	0,625	Medium
X1	Landslides	0,623	Medium
X11	Frequent accidents along transportation routes	0,528	Medium
X6	Decrease in wildlife population	0,499	Medium
X12	Loss of fertile soil layers	0,464	Medium
X14	Groundwater pollution	0,351	Low
X7	Environmental disputes within the village	0,321	Low

Source: Data Processed 2023

The categorization results indicate that three impacts fall into the high category: damage to road infrastructure, air pollution, and loss of rural ambiance. These impacts need to be the top priority in mitigation efforts and policy-making. Other impacts are categorized as moderate and low. Nevertheless, all impacts must be considered and addressed according to their category and level of urgency.

Impact Handling Analysis. From the description of the research results, it is known that the impact categories range from low to high, and these results were validated by experts, all of whom agreed with the findings. Impacts such as damage to road infrastructure (X2), air pollution (X3), and loss of rural ambiance (X5) fall into the high category due to their significant impact and frequency. Therefore, expert recommendations were analyzed for handling these high-category impacts in C Quarry Activities as follows:

1. Damage to Road Infrastructure (X2). Analysis: This impact has a high magnitude and frequency, necessitating severe attention. Road damage can disrupt community activities and increase transportation costs (D'Apuzzo et al., 2022). Therefore, three recommendations are proposed:

a. Special funding allocation. Allocate funds from the community, businesses, and government for repairing and maintaining road infrastructure damaged by C quarry activities.
b. Pro-community and environmental-friendly policies. The government must create regulations governing mining procedures (Dupuy, 2014) and mandate companies to repair road damage caused by their activities.
c. Strict law enforcement against regulatory violators. By enforcing strict laws against violators related to road infrastructure damage, compliance with regulations can be encouraged, traffic safety can be maintained, and roads can remain functional for the community's benefit.

2. Air Pollution (X3). Analysis: Air pollution can endanger public health and disrupt the quality of life. Dust and smoke from C quarry activities can cause respiratory diseases and allergies (Sucipto, 2007). Therefore, two recommendations are proposed:

a. Tight supervision of mining activities. The government must tighten mining activity supervision to ensure compliance with emission standards. Additionally, implementing

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environmentally friendly technology is required to minimize dust and smoke emissions (Hidayat, 2023).

b. Planting trees around mining sites. Trees can help absorb dust and smoke, improving air quality around mining sites (Roy et al., 2020).

3. Loss of Rural Ambiance (X5). Analysis: The loss of rural ambiance can lead to social and cultural changes. The lost beauty of rural landscapes can affect the tourism sector. Therefore, two recommendations are proposed:

a. Reclamation and tree planting in former quarry sites. Reclamation can restore former C quarry land conditions to their original state, and tree planting can help restore the serene rural ambiance (Larder, 2021).

b. Development of former quarry sites as nature tourism destinations. Former C quarry sites can be developed into attractive nature tourism parks (Anwar et al., 2020). This can boost the local economy and provide alternative sources of income for nearby communities.

Handling the impacts of C quarry activities must be comprehensive and sustainable. The government, businesses, and communities need to collaborate to minimize the negative impacts of quarrying and maximize its benefits for society and the environment.

CONCLUSION

From the categorization results, three impacts are classified as high: road infrastructure damage, air pollution, and loss of rural atmosphere. These impacts need to be the main priority in mitigation efforts and policy-making. Meanwhile, other impacts are categorized as moderate and low. However, all impacts must be considered and handled according to their categories and levels of urgency.

Further analysis shows that the impacts of road infrastructure damage, air pollution, and loss of rural atmosphere require serious attention. Recommendations from experts include allocating special funds for infrastructure improvement, implementing policies favoring the community and the environment, strict supervision of mining activities, planting trees around mining sites, and reclamation and development of former mining areas into natural tourist destinations.

Dealing with the impacts of C mining must be done comprehensively and sustainably with cooperation between the government, businesses, and the community to minimize negative impacts and maximize benefits for society and the environment.

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