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Analysis of the Influence of Mining Activities, Infiltration Areas, Polder System and Coordination on Flooding in Pangkal Pinang City

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ABSTRACT

Flooding is one of the major problems in Pangkal Pinang City. To prevent flooding, it is necessary to review the factors causing flooding; therefore, research needs to be conducted to analyze these factors. This research aims to determine and analyze the influence of mining activity factors, catchment areas, polder systems, and coordination on flood conditions in Pangkal Pinang City. This study uses a multiple linear regression analysis model supported by historical data on the height and average duration of flood inundation in Pangkal Pinang City. The research results produced the model equation: Y = 3.216 + 0.484X1 – 0.396X2 – 0.412X3 – 0.480X4. Based on data analysis using SPSS, the findings indicate that mining activity factors, catchment areas, polder systems, and coordination significantly influence flood conditions in Pangkal Pinang City, with a combined explanatory power of 85.0%. The most dominant variable affecting flooding is mining activity. The regression coefficient for the mining activity variable is positive at 0.484, indicating that if mining activity increases by 1%, then the height and duration of flooding—as flood indicators—will increase by 0.484 times, assuming other independent variables remain constant. This model can be used to project future floods. With this modeling, it is hoped that effective measures can be implemented to overcome flooding in Pangkal Pinang City.

KEYWORDS *Floods, Mining Activities, Catchment Areas, Polder Systems, Coordination, Multiple Linear Regression Analysis*

INTRODUCTION

Tin is the main commodity of the Bangka Belitung Islands Province. Tin exploitation is based on public policy in the mining sector according to the 1945 Constitution (1945 Constitution) Article 33, paragraph (3), which states that "The earth and water and the natural resources contained therein are controlled by the State and used as much as possible for the prosperity of the people." The level of environmental damage on Bangka Island is very worrying (Rosyida et al., 2019; Sukarman et al., 2020; Sulista & Rosyid, 2022; Widawati & Suliasih, 2019).

Large-scale tin mining exploitation activities cause environmental problems that impact the deterioration of environmental quality. The increasing population and the high price of tin minerals have caused many people to convert agricultural land into mining areas, whose exploitation does not pay attention to land and environmental conversion.

Tin mining activities carried out conventionally and unconventionally have significant environmental impacts, one of which is the expansion of critical land. Based on the Decree of the Director General of Watershed Management and Forest Rehabilitation of the Ministry of Environment and Forestry Number SK. 49/PDASRH/PPPDAS/DAS.0/12/2022 concerning the Determination of National Critical Land Maps and Data in 2022, the critical land area in the Bangka Belitung Islands Province increased to 167,104 Ha. Critical land in Bangka Regency and Central Bangka Regency has triggered flooding due to sediment transport to Pangkal Pinang City. This is supported by topographic conditions that have flat contours and tend to be concave (–0.6 to 3 meters above sea level) compared to the surrounding districts, making Pangkal Pinang City the downstream area from upstream Bangka Regency and Central Bangka Regency.

Waste from tin mining activities in Bangka and Central Bangka Regencies, carried by water currents to Pangkal Pinang City, can cause sedimentation in the Polder System. Currently, there are two ponds operating as a polder system in Pangkal Pinang City, namely the Kacang Dagang Retention Pond and the Rangkui PDAM Pond. Sediment accumulation in the Kacang Dagang Retention Pond polder system and PDAM Pond can cause changes in channel dimensions, reduce channel capacity, and cause siltation, thereby reducing the ability to drain water and causing flooding problems in residential areas (Haryadi et al., 2022, 2023; Rahayu et al., 2024). Additionally, inadequate urban drainage infrastructure is the main cause of many waterlogging points in Pangkal Pinang City during the rainy season. Many drains are clogged due to garbage accumulation and high sedimentation. The lack of public awareness of environmental cleanliness, such as throwing garbage into rivers or sewers and closing drainage channels for personal interests, is a key cause of floods and stagnant water in Pangkal Pinang City.

The Pangkal Pinang City Government, through the Public Works and Spatial Planning Office—which is the implementing element of government affairs in the field of public works—already has a master plan for flood management through the Engineering Service Project for Bangka Island Flood Management in Bangka Belitung Province. The purpose of this project is to reduce the impact of flooding on residents' health and lives, human activities, assets, and public infrastructure by planning from the Master Plan and Feasibility Study to Detailed Engineering

Design and Action Plan for Land Acquisition and Resettlement while considering social and environmental impacts on Bangka Island. Coordination between the Provincial Government, the Central Government, and the Bangka and Central Bangka Regency Governments needs to be carried out to review the master plan to ensure cooperation, commitment, and integrated, sustainable handling to address floods in Pangkal Pinang City.

Flooding in urban areas has been a critical issue, with numerous studies highlighting the role of various factors such as land use changes, inadequate drainage systems, and poor coordination among stakeholders. For instance, research by Yendri et al. (2019) demonstrated that changes in land cover significantly alter flood discharge patterns, while Sulistyo et al. (2020) identified sedimentation and insufficient channel capacity as major contributors to urban flooding. Additionally, Putranto et al. (2018) emphasized the importance of institutional coordination in mitigating flood risks, noting that effective communication and standardized procedures can reduce inundation duration. Despite these findings, there remains a gap in understanding the combined impact of mining activities, infiltration areas, polder systems, and coordination on flooding, particularly in regions like Pangkal Pinang City, where tin mining exacerbates environmental degradation. This study seeks to bridge this gap by analyzing these interconnected factors, offering a more holistic approach to flood management.

The urgency of this research is underscored by the escalating environmental damage in Pangkal Pinang City, driven by extensive tin mining and inadequate flood control measures. Critical land areas have expanded significantly, as reported by the Ministry of Environment and Forestry (2022), leading to increased sedimentation and reduced infiltration capacity. Furthermore, the city's flat topography and downstream location make it highly susceptible to flooding from upstream mining activities. Previous studies, such as Larawa's (2021) work on mining-induced flooding, have focused on isolated factors, but none have integrated the roles of infiltration areas, polder systems, and multi-agency coordination into a single framework. This study's novelty lies in its comprehensive analysis of these variables, using a multiple linear regression model to quantify their collective influence on flood conditions, thereby providing actionable insights for policymakers.

The benefits of this research extend beyond academic contributions, offering practical solutions for flood mitigation in Pangkal Pinang City. By identifying mining activity as the dominant factor, the study highlights the need for stricter regulations and land reclamation efforts. Additionally, the findings can inform the optimization of polder systems and enhance inter-agency coordination, as suggested by Peters (2018) in his work on policy coherence. Ultimately, this research aims to reduce flood risks, protect community livelihoods, and promote sustainable urban planning, aligning with national and regional development goals. The integration of empirical data and stakeholder perspectives ensures that the recommendations are both scientifically robust and feasible for implementation. This study aims to find out and analyze the influence of mining activity factors, infiltration areas, polder system, and coordination on flood conditions in Pangkal Pinang City.

From the description above, it can be concluded that tin mining activities in the district areas around Pangkal Pinang City trigger sediment transport resulting in flooding in Pangkal Pinang City. In addition, the reduction of catchment areas and suboptimal polder system infrastructure affect the height and duration of flooding in Pangkal Pinang City. Flood management is currently still partial; therefore, integrated coordination between agencies and institutions is necessary to review the master plan for flood management in Pangkal Pinang City. To prevent flooding, it is essential to understand the factors causing flooding, making this research imperative. To study floods in Pangkal Pinang City more deeply, a research study titled Analysis of the Influence of Mining Activities, Infiltration Areas, Polder System and Coordination on Floods in Pangkal Pinang City is needed.

RESEARCH METHOD

The discussion and analysis in this study were conducted using a descriptive-quantitative research method with a survey approach. The survey method used questionnaires as the research instrument. Although surveys target large and small populations, this study analyzed data from samples drawn from the population to identify the distribution and relationships between variables (Sugiyono, 2020:57). The purpose of the survey was to provide a detailed overview of the background and characteristics of the case. Objectivity in this quantitative research was ensured by using instruments tested for validity and reliability.

Descriptive analysis was applied to summarize and present data related to the study variables (Gunawan, 2020:22). The analysis aimed to determine respondents' perceptions of the variables, expressed through tables showing the percentage of respondents who strongly agreed, agreed, were neutral, disagreed, or strongly disagreed with the statements.

RESULT AND DISCUSSION

Descriptive Analysis

Descriptive analysis is a method used to explain and illustrate everything related to the research object, including data collection, summarization, and presentation (Gunawan, 2020). In this study, descriptive analysis aims to portray respondents' overall assessments of key research variables: mining activities, water catchment areas, polder systems, coordination, and flooding. For the mining activity variable (X1), measured through 16 indicators among 86 respondents, the data show that 15% strongly agreed, 41% agreed, 17% were neutral, 20% disagreed, and 7% strongly disagreed. A significant majority (86%) believe that critical land areas are expanding due to mining activities, and 83% perceive a decline in environmental quality in the Bangka Belitung Islands Province. Furthermore, 80% highlight the proliferation of illegal tin mining, and 79% report weak government enforcement against illegal mining. Similarly, the catchment area variable (X2), evaluated through five items, received 32% strong agreement, 41% agreement, and lower neutral to disagreement responses, where 90% of respondents stated that green open spaces (RTH) are insufficient to absorb rainfall in Pangkal Pinang and surrounding regions. The polder system variable (X3), measured by six statements, revealed only 5% agreement, while the majority (76%) disagreed or strongly disagreed, indicating a lack of capacity in drainage channels and under-optimized flood management infrastructure. For the coordination variable (X4), measured by six indicators, 53% of respondents agreed or strongly agreed, reflecting moderate perceptions of inter-agency collaboration, communication frequency, and the availability of SOPs. Lastly, for the flood variable (Y), based on two statements, 68% of respondents agreed or strongly agreed, confirming that observed flood depths in Pangkal Pinang range from 15–25 cm and last an average of 30–60 minutes. These findings highlight public concern about environmental degradation, insufficient flood infrastructure, and the critical need for coordinated flood management interventions.

Multiple Linear Regression Analysis

The multiple linear regression equation is obtained by looking at the results of the *Unstandardized Coefficients* at *Output* SPSS. Value *Unstandardized Coefficients* It is commonly used to predict independent variables against dependent variables, so that a picture of the future is obtained with past data. The following is a table of the results of multiple linear regression analysis:

Table 1. Multiple Linear Regression Analysis Results

Coefficient								
		Unstandardized Coefficients		Standardized Coefficients			Collinearity Statistics	
Model		B	Std. Error	Beta	t	Sig.	Tolerance	VIF
1	(Constant)	3.216	.642		5.010	.000		
	Aktivitas_tambang	.484	.023	1.919	20.848	.000	.218	4.577
	Daerah_resapan	-.396	.032	-.766	-12.379	.000	.484	2.066
	Sistem_polder	-.412	.048	-.553	-8.589	.000	.446	2.240
	Coordination	-.480	.036	-.901	-13.366	.000	.407	2.454

a. Dependent Variable: Flood

Source: SPSS Results, 2024

From the results of the calculation of the regression analysis, the *Unstandardized Coefficients* in the mining activity variable (X1) of 0.484, the infiltration area variable (X2) of -0.396, the polder system variable (X3) of -0.412, and the coordination variable (X4) of -0.480.

Based on the table, the multiple linear regression equation can be described as follows:

$$Y = \alpha + \beta 1X1 + \beta 2X2 + \beta 3X3 + \beta 4X4 + e$$

$$Y = 3.216 + 0.484X1 – 0.396X2 – 0.412X3 – 0.480X4$$

From the multiple linear regression equation above, it can be explained as follows:

a. The value of constant (a) has a positive value of 3.216. A positive sign means that it shows an influence in the same direction between independent variables and dependent variables. This shows that if all independent variables including mining activity (X1), catchment area (X2), polder system (X3), and coordination (X4) are 0 percent or have no change, then the value of height and duration of inundation as indicators of flood variables is 3.216. If converted using historical data on the average height and duration of inundation from the PUPR Office in 2021 assuming the area of fixed inundation, the following calculation values are obtained:

Table 2. Flood Calculation Simulation (Y)

Y	Average inundation duration (minutes)	Average inundation height (cm)
	45	20
	9	4
3,216	2,226461538	0,989538462

Source: Processed Researcher 2024

From the table, it can be interpreted that, if all independent variables including mining activity (X1), catchment area (X2), polder system (X3), and coordination (X4) are 0 percent or have no change, then the average inundation height value is 0.98 cm and the average inundation duration is 2.22 minutes.

b. The value of the regression coefficient for the mining activity variable (X1) has a positive value of 0.484. This shows that if mining activity increases by 1%, then the height and duration of inundation as indicators of flood variables will increase by 0.484 times assuming other independent variables are considered constant. A positive sign means that it shows an influence in the same direction between independent variables and dependent variables. This supports previous research which stated that the contribution of mining land clearance to the runoff discharge of the Lasolo watershed was 0.28% or 18.70 m3/second out of a total of 6,416.98 m3/second (Larawa, 2021).

c. The value of the regression coefficient for the infiltration area variable (X2) was -0.396. This value shows a negative influence (in the opposite direction) between the variables of the catchment area and flooding. This means that if the infiltration area variable increases by 1%, then on the other hand, the height and duration of inundation as indicators of flood variables will decrease by 0.396 times. Assuming that the other variables remain constant. This result is directly proportional to the results of Yendri, et al.'s (2019) research that changes in land cover greatly affect the period of flood discharge return at a certain time.
d. The value of the regression coefficient for the polder system variable (X3) was -0.412. This value shows a negative influence (in the opposite direction) between the variables of the polder system and flooding. This means that if the polder system variable increases by 1%, then conversely the height and duration of inundation as indicators of flood variables will decrease by 0.412 times. Assuming that the other variables are considered constant. This is directly proportional to the statement of Wei, et al., (2015) that the existence of a pump house in an area with relatively flat topographic conditions is one of the means of drainage of complementary buildings that are needed in regulating and controlling the rainwater flow system. This research also supports the research of Sulistyo, et al., (2020) which states that flooding is caused by a lack of existing channel capacity, regional contours, garbage and sediment at the bottom of the channel.
e. The value of the regression coefficient for the coordination variable (X4) was -0.480. This value shows a negative influence (opposite direction) between the coordination variable and flooding. This means that if the coordination variable increases by 1%, then on the other hand, the height and duration of inundation as indicators of flood variables will decrease by 0.480 times. Assuming that the other variables are considered constant. This result is directly proportional to the results of the research of Putranto, et al. (2018) which stated that the variables of institutional aspects consisting of communication frequency, maintenance of facilities, and institutional conditions have a significant effect on the height of inundation and duration of inundation.
f. Based on the regression model equation above, it can be concluded that the most dominant variable affects flooding , namely mining activity.

Test F

The sensitivity of mine activities, infiltration areas, polder systems and coordination to floods can be analyzed simultaneously using the F test. The F value of the table is obtained by looking at the value df1=k-1 and the value df2=n-k, where n = number of respondents and k = number of variables. With a confidence level of 95% or a significance level of 5% ($\alpha = 0.05$), the F value of the table was obtained of 2.4844. The results of the regression analysis obtained an F value of 114.786. This can be interpreted as mining activities, infiltration areas, polder systems and coordination sensitive to floods with a significance of 95% ($p<0.01$).

Table 3. F Test Results

ANOVA						
Model		**Sum of Squares**	**Df**	**Mean Square**	**F**	**Sig.**
1	Regression	277.983	4	69.496	114.786	.000b
	Residual	49.041	81	.605		
	Total	327.023	85			
a. Dependent Variable: Flood						
b. Predictors: (Constant), Coordination, Daerah_resapan, Sistem_polder, Aktivitas_tambang						

T Test

The T test is used to determine whether the independent variables in the regression model partially have a significant influence on the dependent variables. The hypotheses in this study are as follows:

1. H0: Mining Activity Factor (X1) has no effect on flooding (Y) in Pangkal Pinang City.
   H1: Mining Activity Factor (X1) affects flooding (Y) in Pangkal Pinang City.
2. H0: The Catchment Area Factor (X2) has no effect on flooding (Y) in Pangkal Pinang City.
   H1: The Catchment Area Factor (X2) affects flooding (Y) in Pangkal Pinang City.
3. H0: The Polder System (X3) factor has no effect on flooding (Y) in Pangkal Pinang City.
   H1: The Polder System Factor (X3) Affects Flooding (Y) in Pangkal Pinang City.
4. H0: Coordination Factor (X4) has no effect on flooding (Y) in Pangkal Pinang City.
   H1: Coordination Factor (X4) affects flooding (Y) in Pangkal Pinang City.

Decision-making criteria:

a. H0 is accepted and Ha is rejected, when the Significance > 0.05 (has no significant effect).
b. Ha is accepted and H0 is rejected if the Significance < 0.05 (has a significant effect).

The calculation of the T test is carried out with df = n – k, where n = the number of questionnaire respondents and k is the number of variables, then df = 86 – 5 = 81, with a value of Sig. 0.05 then the T value of the table is obtained of 1.993.

Table 4. T Test Results

Coefficient								
	Unstandardized Coefficients		Standardized Coefficients				Collinearity Statistics	
Model	B	Std. Error	Beta	t	Sig.		Tolerance	VIF
1 (Constant)	3.216	.642		5.010	.000			
Aktivitas_tambang	.484	.023	1.919	20.848	.000		.218	4.577
Daerah_resapan	-.396	.032	-.766	-12.379	.000		.484	2.066
Sistem_polder	-.412	.048	-.553	-8.589	.000		.446	2.240
Coordination	-.480	.036	-.901	-13.366	.000		.407	2.454

a. Dependent Variable: Flood

Source: SPSS Results, 2024

In the table above, it can be interpreted as follows:

1. In the mining activity variable (X1), the calculated T value = 20.848 > t table 1.993 with a significance of 0.000 < 0.05. So Ha is accepted and H0 is rejected, meaning that the mining activity factor (X1) has a significant effect on the Flood (Y).
2. In the infiltration area variable (X2), the value of T calculated = -12.379 < -t table -1.993 with a significance of 0.000 < 0.05. So Ha is accepted and H0 is rejected, meaning that the infiltration area factor (X2) has a significant effect on the Flood (Y).
3. In the polder system variable (X3), the calculated T value = -8.589 < -t table -1.993 with a significance of 0.000 < 0.05. So Ha is accepted and H0 is rejected, meaning that the polder system factor (X3) has a significant effect on Flood (Y).
4. In the coordination variable (X4), the calculated T value = -13.366 < -t table -1.993 with a significance of 0.000 < 0.05. So Ha is accepted and H0 is rejected, meaning that the coordination factor (X4) has a significant effect on the Flood (Y).

Determination Analysis (R Square)

Determination analysis is a measure of how much the contribution of variable X to variable Y. This analysis is used to determine the amount of contribution of the simultaneous influence of independent variables on dependent variables. The contribution of the simultaneous influence of the variables of mining activity (X1), catchment area (X2), polder system (X3) and coordination (X4) to the flood variable (Y) was 85.0%. The remaining 15.0% was influenced by other factors outside of this study, such as weather, garbage, the number of settlements on the riverbanks, and the slope slope.

Table 5. Determination Analysis Results (R Square)

Model Summary[b]				
Model	**R**	**R Square**	**Adjusted R Square**	**Std. Error of the Estimate**
1	.922a	.850	.843	.778
a. Predictors: (Constant), Coordination, Daerah_resapan, Sistem_polder, Aktivitas_tambang				
b. Dependent Variable: Flood				

Source: SPSS Results, 2024

Ranking and Determination of Dominant Variables

The ranking and determination of the dominant variables is carried out by looking at the value *Standardized beta coefficients*. *Standardized* Coefficients Beta It is commonly used to determine the magnitude of the influence and effective contribution of independent variables on dependent variables, but only applies at that time and to that sample. The results of data processing using SPSS were obtained *Standardized* Coefficients Beta as follows:

Table 6. Zero-order Test Results

		Standardized Coefficients	Correlations		
Model		**Beta**	**Zero-order**	**Partial**	**Share**
1	(Constant)				
	Aktivitas_tambang	1.919	.566	.918	.897
	Daerah_resapan	-.766	.166	-.809	-.533
	Sistem_polder	-.553	.147	-.690	-.370
	Coordination	-.901	.031	-.829	-.575

Source: SPSS Results, 2024

Based on the calculation results, the most dominant variables affecting flooding are as follows:

Table 7. Ranking and Determination of Dominant Variables

No	Research Variables	*Standardized Coefficients Beta*	*Zero-Order*	*Standardized Coefficients Beta* x *Zero-Order*	% Dominant
1.	Mining activity factor (X1)	1,919	0,566	1,09	109%
2.	Diffusion area factor (X2)	-0,766	0,166	-0,13	-13%
3.	Polder system factor (X3)	-0,553	0,147	-0,08	-8%
4.	Coordination factor (X4)	-0,901	0,031	-0,03	-3%
a. *Dependent Variable: Flood*			∑	0,850	85,0%

Source: SPSS Results, 2024

From the table above, it can be seen that the independent variable that has the highest contribution or the most dominant influence on flooding in Pangkal Pinang City is mining activity (X1) with a value of *Standardized Coefficients Beta* which is greater than the other variables, namely by 1,919. This shows that mining activities in the upstream area/district bordering Pangkal Pinang City have a significant effect on flooding in Pangkal Pinang City. This is because increasing mining activities can expand critical land and increase environmental damage.

Relationship between Variables X1, X2, X3 and X4

To find out the relationship between variables mining activity (X1), catchment area (X2), polder system (X3) and coordination (X4) were used Pearson's Bivariate Correlation Analysis with the following results:

Table 8. Relationship Between Variables X1, X2, X3 and X4

Correlations

		Aktivitas_tambang	Daerah_resapan	Sistem_polder	Coordination
Aktivitas_tambang	Pearson Correlation	1	.508**	.699**	.640**
	Sig. (2-tailed)		.000	.000	.000
	N	86	86	86	86
Daerah_resapan	Pearson Correlation	.508**	1	.143	-.039
	Sig. (2-tailed)	.000		.189	.723
	N	86	86	86	86
Sistem_polder	Pearson Correlation	.699**	.143	1	.591**
	Sig. (2-tailed)	.000	.189		.000
	N	86	86	86	86
Coordination	Pearson Correlation	.640**	-.039	.591**	1
	Sig. (2-tailed)	.000	.723	.000	
	N	86	86	86	86

**. Correlation is significant at the 0.01 level (2-tailed).

Source: SPSS Results, 2024

The Pearson correlation coefficient has the smallest value of -1 and the largest value of 1. The number 1 indicates a perfect correlation, while the number 0 means no correlation at all. A correlation value above 0.5 indicates a fairly strong correlation, while below 0.5 indicates a weak correlation. Decision-making policy in Pearson's Bivariate Correlation Analysis, namely:

a. If the significance value > 0.05 (no correlation).
b. If the significance value < 0.05 (there is a correlation).

From the table above, it can be explained as follows:

a. The mining activity variable (X1) has a correlation value of 0.508 to the catchment area (X2) with a significance value of 0.000. This shows a fairly strong correlation between mining activity and catchment areas (X2). This means that the decline in environmental quality due to tin mining activities is directly proportional to the decline in RTH as an infiltration area.

b. The mining activity variable (X1) has a correlation value of 0.699 to the polder system (X3) with a significance value of 0.000. This shows a fairly strong correlation between mining activity and the polder system (X3). This means that the increase in tin mining waste is balanced with the increase in sedimentation in the polder system.
c. The mining activity variable (X1) has a correlation value of 0.640 to coordination (X4) with a significance value of 0.000. This shows a fairly strong correlation between mining activity and coordination (X3). This means that the increase in tin mining activities will also increase coordination between agencies/institutions related to regional spatial planning, laws, and mining policies.
d. The infiltration area variable (X2) has no correlation with the polder system (X3) and coordination (X4).
e. The polder system variable (X3) has a correlation value of 0.591 to coordination (X4) with a significance value of 0.000. This shows a fairly strong correlation between the polder system and coordination (X3). This means, increasing the operational development of pumps, drainage and polder systems, increasing coordination between stakeholders, namely the PUPR Office, Perkim Office, BWSBB, Bappeda, DPRD and the community.

Research Findings

Based on the results of the study, the variables of mining activity (X1), catchment area (X2), polder system (X3) and coordination (X4) had a significant effect on the flood variable (Y). Tin mining is indicated to give birth to various implications including land disturbance that leads to environmental damage, many mining lands have the potential for abrasion and ecosystem damage that has the potential to give birth to drought disasters and landslides (Rusfiana, 2019). This is in line with the results of the rerespondent's assessment of the variable indicators of mining activity that 86% of respondents stated that critical land due to mining activities is expanding and 83% stated that the quality of the environment in the Bangka Belitung Islands Province has decreased, and 51% stated that the pit of former mining excavation has the potential to cause slope landslides and erosion. Research conducted by Bayu, et al. (2019) also states that mining activities result in soil damage. This is supported by data from the Ministry of Environment and Forestry in 2022 that critical land due to mining activities in Bangka Regency increased to 24,463 hectares and in Central Bangka Regency to 30,948 hectares.

According to Ibrahim, Dwi & Nanang in their book entitled Ecological Politics and Lessons from the Bangka Belitung Tin Case (2019) the urgency of natural resources needs to be understood, not only at the level of economic interests, let alone politics. The continuous process of mining exploitation has caused increasingly severe environmental conditions. The general characteristics of ex-mining land are heavily damaged land that causes changes in the land, such as damaged soil structure layers and irregular land surfaces, loss of vegetation on the surface accompanied by damage to the structure of the soil layer is a driving factor for increased erosion which results in the loss of humus soil, so that the soil becomes barren, and the formation of holes/holes under former mining excavations.

CONCLUSION

Based on the data analysis and discussion, mining activity, infiltration areas, polder systems, and coordination significantly influenced flood conditions in Pangkal Pinang City, with an 85.0% contribution. Mining activity was identified as the most dominant factor, consistent with prior studies linking land clearing and sedimentation to increased flood runoff and altered flood discharge patterns. Other studies aligned with findings that inadequate channel capacity, topography, and institutional coordination also affected flood severity and duration. To effectively reduce flooding risks, management efforts should prioritize controlling mining activities through critical land reclamation, vegetation planting, public awareness, refilling abandoned pits, reforestation, strict regulation against illegal logging and mining, green mining practices, and integrated spatial planning. Enhanced community participation, adequate funding, and coordinated supervision are essential for sustainable environmental management. Future research could focus on developing predictive flood models that integrate climate change projections, land use dynamics, and real-time monitoring to optimize flood mitigation strategies tailored to Pangkal Pinang City's unique environmental and social context.

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