Community Perceptions of the Impact of Marine Sand Mining Activities in the Riau Islands Province

Persepsi Masyarakat terhadap Dampak Kegiatan Pertambangan Pasir Laut di Wilayah Provinsi Kepulauan Riau

Samsul Bahri[1], Khodijah Ismail[1*], Sayyidah Nur Habibah[1]
[1]Department of Environmental Science, Postgraduate,
Universitas Maritim Raja Ali Haji, Tanjung Pinang 29124 Indonesia
*email: khodijah@umrah.ac.id

Abstract

This study aims to determine the perceptions of local communities towards marine sand mining activities in the Kepulauan Riau Province. Considering the region's dominance, Kepulauan Riau has great potential for sand mining in terms of quality and quantity. The population dynamics and high development today encourage an increased need for sand. Therefore, sand mining businesses have become social, economic, and ecological. This research uses a descriptive qualitative approach with an interview method with 60 respondents. Multiple linear regression analysis was used to predict perceptions based on social, economic, and ecological variables. The results showed that social aspects (coefficient value of 0.809) strongly influenced the sustainability of mining activities compared to ecological aspects (0.271) and economic aspects (-0.045). This finding shows that if mining activities can create good social conditions in local communities, sand mining activities can continue. However, these social conditions are related to the ecological impacts caused by mining.

Keywords: Mining, Sea Sand, Perception, Local Community.

Abstrak

Tujuan dari penelitian ini adalah untuk mengetahui persepsi masyarakat lokal terhadap aktifitas penambangan pasir laut di wilayah Propinsi Kepulauan Riau. Kepulauan Riau memiliki potensi besar untuk pertambangan pasir, baik dari segi kualitas maupun kuantitas mengingat dominasi wilayahnya merupakan perairan laut dan beragam pulau yang memiliki formasi geologi yang kaya akan pasir silika dan pasir kuarsa. Dinamika penduduk dan pembangunan yang tinggi saat ini mendorong terjadinya peningkatan kebutuhan pasir, sehingga keberadaan usaha pertambangan pasir menjadi suatu fenomena di tengah-tengah masyarakat dari aspek sosial, ekonomi dan ekologinya. Penelitian ini menggunakan pendekatan deskriptif kualitatif dengan metode wawancara kepada 60 responden. Analisis regresi linier berganda digunakan untuk memprediksi persepsi berdasarkan variabel aspek sosial, ekonomi dan ekologi. Hasil penelitian menunjukkan aspek sosial (nilai koefisien 0,809) sangat mempengaruhi keberlanjutan kegiatan pertambangan dibanding aspek ekologi (0,271) dan aspek ekonomi (-0,045). Temuan ini menunjukkan bahwa apabila aktifitas pertambangan dapat menciptakan kondisi sosial yang baik pada masyarakat lokal maka aktifitas pertambangan pasir dapat terus berlanjut. Namun pada sisi lain kondisi sosial tersebut berkaitan dengan dampak ekologi yang ditimbulkan akibat pertambangan tersebut.

Kata kunci: Pertambangan, Pasir Laut, Persepsi, Masyarakat Lokal

1. Introduction

Marine sand mining is increasingly prevalent in various coastal areas, including Indonesia. Marine sand is an important commodity in multiple industries, from construction to glass and electronics manufacturing. However, despite its economic benefits, marine sand mining has significant ecological, social, and economic impacts (Anugerah, 2021). These impacts are often poorly anticipated by industry players and the government, leading to complex and intractable long-term problems. Marine sand mining activities directly affect marine ecosystems. Sand mining can cause damage to the seabed habitat, which impacts the lives of marine life, such as coral reefs, fish, and other organisms. Coral reefs, home to various marine species, can suffer physical damage from sand dredging, reducing their ability to grow and reproduce. In addition, sand removal can alter the structure of the seabed, resulting in the loss of shelter and foraging grounds for various marine species (Rukman et al., 2021).

The export of sea sand has become a hotly debated national environmental issue following the issuance of Government Regulation No. 26 in 2023 on the Management of Sedimentation Results in the sea. This policy ended the temporary ban on the export of sea sand that had been in place for 20 years by President Megawati. The government argues that this policy is strategic in restoring coastal areas following the mandate of the Marine Act, with the Ministry of Marine Affairs and Fisheries (KKP) responsible for maintaining ocean health (Rante, 2021). However, this policy has been sharply criticized by environmental experts and activists who fear long-term negative impacts, such as changes to coastal structures, sea level rise, and habitat destruction of marine organisms that threaten the livelihoods of coastal communities.

Sedimentation caused by sand mining also has a negative impact on seawater quality. Sand particles suspended in the water can reduce sunlight penetration, essential for the photosynthesis of marine plants such as seaweed and phytoplankton. This decrease in marine plant populations impacts the marine food chain, reducing food sources for fish and other aquatic animals (Nugraha, 2024). Sedimentation can also disrupt water flow and ocean current patterns, affecting nutrient distribution in these waters (Yansen et al., 2023). In addition, natural assets are one of the most important assets in sustainable livelihood assets and play a very important role in maintaining the sustainability of human life and the surrounding environment (Ismail & Habibah, 2023)

Socially, marine sand mining also causes problems for coastal communities. Many coastal communities depend on the sea for their livelihoods, whether as fishermen, seaweed farmers, or craftsmen who use raw materials from the sea. Damage to marine ecosystems from sand mining can reduce fish catches and seaweed production, reducing the income of coastal communities. This loss of livelihood can lead to poverty, exacerbate social inequality, and increase population migration from coastal villages to big cities in search of better economic opportunities (Tan & Siregar, 2021). Therefore, sustainable livelihoods take into account how social and natural systems interact, where these reactions will influence sustainability challenges that can meet the livelihood needs of current and future generations (Khodijah, 2014)

Social conflicts are also shared between sand mining companies and local communities. Often backed by the government or large financiers, mining companies can override local communities' rights to land and natural resources. This creates injustice and a sense of discontent among communities, sometimes fuelling protests and resistance (Sari, 2023). Such conflicts damage social norms and disrupt regional development and stability. Sea sand mining benefits a few parties, especially mining companies and parties involved in the supply chain. Revenues from selling sea sand can contribute significantly to the regional and state economies, especially by paying taxes and levies (Samad et al., 2021).

Long-term negative economic impacts often outweigh short-term benefits. Damage to marine ecosystems that reduce fish catches and seaweed production reduces the income of coastal communities on an ongoing basis. In addition, the cost of restoring environments damaged by sand mining is often substantial and time-consuming (Safrizal, 2024). The government and communities must spend much money to repair this damage, which could have been allocated to developing other more sustainable sectors. Infrastructure damage can also occur due to marine sand mining. Coastal erosion caused by seabed subsidence can threaten the existence of public buildings and facilities in coastal areas. As a result, the cost of repairing and maintaining infrastructure also increases, ultimately burdening local budgets and hampering economic development (Harefa et al., 2022).

It is clear from the above that marine sand mining has complex and multidimensional impacts. Although it benefits some parties economically, the adverse ecological and social effects are far more extensive and detrimental. Therefore, the government and the community must review sea sand mining policies, considering the balance between economic benefits, environmental sustainability, and social welfare. The application of sustainability principles and the active participation of local communities in decision-making are important steps that must be taken to ensure that these activities do not come at the expense of the future of the environment and communities.

2. Material and Method

2.1. Time and Place

The study was conducted from March to April 2024 in the Kepulauan Riau Province.

2.2. Methods

This research uses descriptive quantitative methods to assess marine sand mining activities' ecological, social, and economic impacts. This method aims to describe existing phenomena systematically and accurately based on data obtained from the population under study. The population in this study is coastal communities in areas affected by marine sand mining activities. This research uses a total sampling technique, which takes the entire population as the research sample. Thus, the number of samples taken in this study was 60 people, all of whom were coastal residents directly affected by marine sand mining activities (Sugiyono, 2018). Data were collected through a questionnaire designed to evaluate the ecological, social, and economic impacts of marine sand mining. The questionnaire included questions related to changes in the marine environment, impacts on the social and economic life of the community, and community perceptions of marine sand mining policies. In addition, in-depth interviews were conducted with several key informants to understand the issues better. The data obtained was analyzed using descriptive statistical techniques to describe the frequency, percentage, and distribution of each variable studied (Creswell, 2014). The results of this analysis will provide a clear picture of the impacts of marine sand mining activities on the ecology, society, and economy of coastal communities.

2.3. Procedure

The distribution of research data collection used the Google Form application, which was distributed to respondents online and reached all city districts in Kepulauan Riau province.

2.4. Observation Parameters

This study used a questionnaire instrument with a Likert scale of 1-5 to measure marine sand mining activities' ecological, social, and economic impacts. The Likert scale was used because of its ability to capture respondents' level of agreement or disagreement with the statements provided, making it easier to quantify their perceptions and experiences. Each question in the questionnaire was measured using this scale, where a value of 1 indicates 'strongly disagree' and a value of 5 indicates 'strongly agree'. The questions were structured in such a way as to cover various aspects of impacts, ranging from changes in the marine environment and impacts on economic welfare to changes in the social dynamics of coastal communities.

2.5. Data Analysis

This study uses several data analysis techniques to ensure the accuracy and reliability of research instruments and test the relationship between existing variables. The methods used include validity tests, reliability tests, normality tests, and multiple regression tests.

3. Result and Discussion

3.1. Validity Test

Table 1 shows the validity test results for the variables used in this study, namely ecological aspects (X1), social aspects (X2), economic aspects (X3), and community perception (Y). The validity value for each variable is 0.768 for Ecological Aspects, 0.785 for social aspects, 0.867 for economic aspects, and 0.706 for community perception. Based on these results, all variables are declared valid because the correlation value obtained exceeds the minimum limit of 0.3, which is generally used as a standard for determining the validity of research instruments. This high correlation value indicates that the items in the questionnaire consistently measure the intended concept and can describe the relevant variations in the data.

Table 1. Validity test results

Variable	Value	Description
Ecological aspects (X1)	0.768	Valid
Social aspects (X2)	o.785	Valid
Economic aspects (X3)	0.867	Valid
Community perception (Y)	0.706	Valid

Economic Aspects (X3) obtained the highest validity value with a value of 0.867, indicating that the items measuring economic aspects are highly consistent and relevant in the context of this study. Social Aspects (X2) and ecological aspects (X1) also show strong validity with values of 0.785 and 0.768, respectively, signalling that the items in these variables also have a good consistency. Community perception (Y) has a validity value of 0.706, which, although lower than the other variables, is still above the minimum limit and indicates that this instrument remains valid for measuring community perceptions of the impacts of marine sand mining. These results provide confidence that the instruments used in this study can accurately and reliably measure various aspects of the implications of sea sand mining following the research objectives.

3.2. Reliability Test

Table 2 shows the results of the reliability test for the variables used in this study, namely ecological aspects (X1), social aspects (X2), economic aspects (X3), and community perception (Y). Reliability is measured using the Cronbach Alpha coefficient, with a cut-off value of 0.70 generally used to determine whether an instrument is reliable. The test results show that all variables have Cronbach Alpha values above 0.70, indicating that the instruments used in this study have excellent internal consistency and are reliable.

Table 2. Validity test results

Variable	Cronbach Alpha	Cut of value	Description
Ecological aspects (X1)	0.934	0.70	Reliable
Social aspects (X2)	o.833	0.70	Reliable
Economic aspects (X3)	0.955	0.70	Reliable
Community perception (Y)	0.867	0.70	Reliable

Economic Aspects (X3) has the highest Cronbach Alpha value of 0.955, indicating that the items in this variable are highly consistent and reliable in measuring the economic impacts of marine sand mining activities. The ecological aspect (X1) also showed very high reliability with a value of 0.934, followed by community perception (Y) with a value of 0.867, and social aspect (X2) with a value of 0.833. These values indicate that the questionnaires used to measure t can produce consistent data when used repeatedly under the same conditions. Thus, the reliability test results provide confidence that the research can measure the variables under study consistently and reliably for further analysis.

3.3. Normality Test

The normality test aims to determine whether the residual values tested have a normal data distribution, which can be analyzed through the following methods. First, normally distributed data on the histogram graph will form a bell-shaped curve, with data spread evenly on both sides. Second, the assumption of normality is considered unfulfilled if the data spreads far from the diagonal line and does not follow the direction of the diagonal line. The data normality test was performed using a graphical method with the P-P Plot, histogram, and significance value in the Kolmogorov-Smirnov test. The results of the normality test research can be seen as follows:
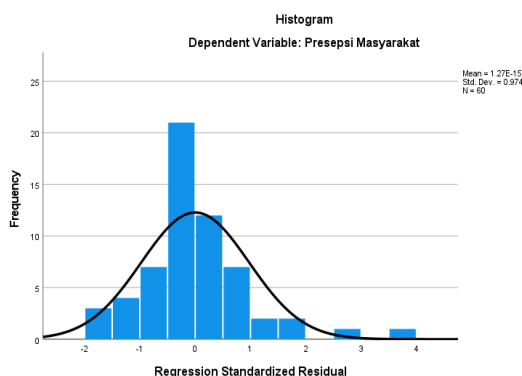

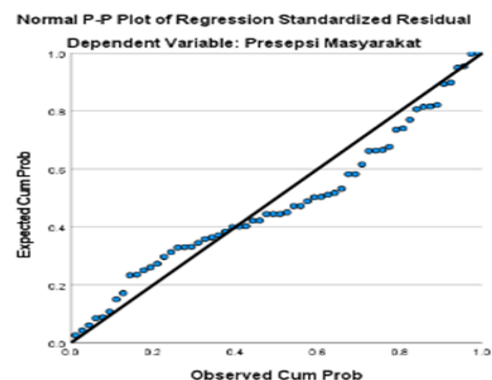Figure 1. Histogram dependent variable community perception

Figure 2. Normal P plot of regression standardized residual

Figure 1 shows the distribution of standardized residuals of the dependent variable 'Community Perception' in this study. Residual distribution is one of the important indicators to test the normality assumption in linear regression. In this histogram, it can be seen that most of the residuals are clustered around the zero value, with a symmetrical distribution on both sides, although there are some outliers at the extreme values. The normal curve (black line) added on top of the histogram shows that the residual distribution is quite close to a normal distribution, with a very small mean (1.27E-15) and standard deviation of 0.974, indicating that the residuals do not deviate far from the mean.

The normality test is important to ensure that the basic assumption of linear regression is met: the residuals must be normally distributed. If this assumption is met, the regression analysis results will be more valid and reliable. This histogram shows that the residual distribution is relatively normal, with most data distributed around the mean and a consistent spread. Although there are some outliers, the overall distribution shows a pattern quite close to a normal distribution, which supports the validity of the regression model used in this study. This means that the regression analysis can provide reliable results in measuring the impact of the independent variables on community perceptions of marine sand mining activities.

The Normal P-P Plot Figure 2, displays the distribution of standardized residuals of the dependent variable 'community perception'. In the P-P Plot, the data points representing the residual values are expected to follow

the diagonal line, which indicates a normal distribution. Figure 2 shows that most data points are near the diagonal line, indicating that the residuals reasonably follow the normal distribution. Some small deviations from the diagonal line can be seen, but they are not significant. This indicates that the regression model fulfils the assumption of normality, which is important for the validity of the regression analysis results. Thus, this near-normal distribution of residuals strengthens the model's reliability in measuring the influence of the independent variables on community perceptions of marine sand mining activities.

3.4. Multiple Linear Regression Analysis

This multiple linear regression analysis examines the influence of three independent variables, namely ecological aspects (X1), Social Aspects (X2), and Economic Aspects (X3), on the dependent variable, namely Community Perception. Based on the coefficient Table 3, the regression equation obtained is:

Table 3. Multiple linear regression analysis results

Model	Unstandardized coefficients		Standardized coefficients	t	Sig.
	B	Std. Error	Beta		
1 (Constant)	-1.529	1.353		-1.130	.263
Ecological aspects (X1)	.271	.032	.304	8.586	.000
Social aspects (X2)	.809	.038	.768	21.363	.000
Economic aspects (X3)	-.045	.023	-.055	-1.929	.059
a. Dependent variable: Community perception					

The analysis reveals a significant influence of ecological and social aspects on community perception of composting initiatives. A one-unit increase in the perceived ecological benefits of composting leads to a 0.271 unit increase in positive community perception, highlighting the importance of environmental advantages in shaping public opinion. Notably, social aspects exert the strongest influence, with a one-unit increase in perceived social benefits resulting in a substantial 0.809-unit increase in community perception. This underscores the crucial role of community engagement and social cohesion in the success of composting programs. While economic aspects influenced community perception negatively, this effect was not statistically significant, suggesting that economic factors may not play a decisive role in shaping public opinion towards composting in this context. This linear regression model shows that ecological aspects and social aspects significantly influence Community Perceptions, with Social Aspects contributing the most. Despite having a negative coefficient, the Economic Aspect does not significantly affect this model.

3.5. The Effect of Ecological Aspects (X1) on Community Perceptions (Y)

The results of multiple linear regression analysis show that the Ecological Aspect has a coefficient of 0.271 with a significance value of 0.000, which indicates that improving the quality of ecological aspects is positively correlated with improving community perceptions. When marine sand mining activities focus on and improve ecological aspects, communities tend to have more positive perceptions of these activities. This includes actions such as rehabilitation of marine ecosystems, good management of mining waste, and efforts to reduce negative impacts on the surrounding environment. Previous research also indicates similar findings. The study Githiria & Onifade, (2020) found that coastal communities have a more favorable perception of mining companies implementing environmentally friendly practices. Mining activities that pay attention to ecology, such as minimizing damage to coral reefs and keeping waters clean, help build trust and support from local communities. This suggests that attention to ecological aspects in marine sand mining activities is important for environmental conservation and social relations between companies and communities. Research Mark (2021) showed that company transparency and communication about ecological impacts and mitigation measures influence community perceptions of marine sand mining activities. When companies proactively inform communities about ecological measures and demonstrate their commitment to environmental conservation, communities tend to provide greater support. This reflects the importance of engagement and effective communication in shaping positive perceptions of mining activities.
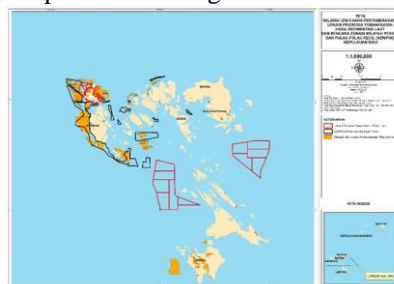

Figure 3. Map of Mining sites, priority locations for utilisation of marine sedimentation results, and zoning plan for coastal areas and small islands of Kepulauan Riau Province

In the context of this study, the results show a positive coefficient for ecological aspects, which reinforces the importance of incorporating environmental considerations in marine sand mining activities. This not only serves to reduce negative impacts on marine ecosystems but also helps in building positive relationships with neighbouring communities. An approach that focuses on ecological sustainability can be an effective tool to gain community support and ensure the long-term sustainability of mining operations. By integrating eco-friendly practices, companies can balance resource exploitation and environmental preservation, ultimately improving community perceptions of the mining industry.

3.6. The Effect of Social Aspects (X2) on Community Perceptions (Y)

Based on multiple linear regression analysis, the Social Aspect has a coefficient of 0.809 with a significance value 0,000. This indicates that the Social Aspect has a very strong and positive influence on community perceptions. This means that the better the social conditions resulting from sea sand mining activities, the more positive the community perceives these activities. These social aspects include community welfare, availability of jobs, and community involvement in decision-making. These results align with research by Segreto et al. (2020), showing that community participation and social benefits received by local communities strongly influence their perceptions of industrial projects. The study by Baba et al. (2021) found that community perceptions of extractive projects, such as mining, depend largely on the extent to which communities feel involved and receive economic benefits. When communities feel they are part of the process and receive direct benefits such as jobs and improved infrastructure, their perceptions tend to be more positive.

The finding that Social Aspects significantly affect community perceptions in marine sand mining activities confirms the importance of mining companies focusing on social development. Companies must ensure that their activities provide tangible benefits to local communities, whether in employment, infrastructure improvements, or community development programs. By doing so, companies can build better community relationships and gain greater support for their operations. Paying attention to social aspects helps gain positive perceptions from communities and contributes to the long-term sustainability of mining activities.

3.7. The Effect of Economic Aspects (X3) on Community Perceptions (Y)

Based on multiple linear regression analysis, the Economic Aspect has a coefficient of -0.045 with a significance value of 0.059, which shows a negative but statistically insignificant influence on community perceptions. This means that while the economic impacts of marine sand mining activities may exist, they are not strong enough to influence community perceptions significantly. This suggests that communities may have concerns or opposing views regarding the economic aspects of marine sand mining activities. This finding aligns with several previous studies that show that the community does not always receive the economic impacts of mining projects positively. Research by Worlanyo & Jiangfeng (2021) shows that while mining projects can generate economic benefits, such as job creation and increased income, negative impacts, such as long-term economic instability and unfair distribution of profits, often negatively influence community perceptions. Communities may feel that the economic benefits do not outweigh the disadvantages they experience, such as environmental degradation and loss of traditional livelihoods.

The results of this study suggest that mining companies need to pay more attention to the distribution of economic benefits and ensure that all members of the community feel positive economic impacts equally. Moreover, companies should develop strategies to reduce the economic dependence of communities on mining activities and invest profits in long-term sustainable economic development programs. By doing so, companies can help improve community perceptions of marine sand mining and create more positive relationships with local communities.

4. Conclusions

Based on the overall results of the research above, it can be concluded that sand mining activities in Kepulauan Riau Province are considered from community perceptions and will continue if they can create good social conditions for local communities. This does not mean there will be any ecological impact, but people's perceptions will be more likely to pay attention to social aspects. Similarly, although the economic aspect does not impact local communities, it is not a severe concern for the community. Companies must adopt a holistic approach to improve positive community perceptions of marine sand mining activities. This includes mitigating adverse environmental impacts, managing social impacts wisely, and ensuring equitable and sustainably shared economic benefits. An integrated and sustainability-orientated approach can help create a more harmonious relationship between companies and local communities.

5. Suggestion

Based on the findings of this study, it is recommended that marine sand mining companies strengthen their corporate social responsibility (CSR) programs, implement environmentally friendly mining practices, and

involve local communities in decision-making processes. By doing so, companies can build trust and increase the community's positive perception of marine sand mining activities.

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