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Environmental Management Strategies in Overcoming Impacts Sand Mining on the Cumbadak River and Tuak River

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Abstract

Intensive sand mining in the Siulak Deras area, Kerinci Regency, has had a serious impact on the ecosystem of the Cumbadak River and Tuak River. This activity triggers damage to river morphology, decreased water quality, and disrupts the balance of aquatic ecosystems. This research aims to formulate appropriate environmental management strategies to reduce and control the negative impacts of sand mining activities in the area. The approach used was a SWOT analysis and TOWS strategy matrix, combined with the results of field observations and in-depth interviews with relevant stakeholders. The results of the study show that weak supervision, lack of community involvement, and inconsistent implementation of environmental documents are the main challenges in managing the impacts of sand mining. The recommended strategies include strengthening community-based supervision, implementing environmentally friendly technology, revitalizing watersheds, and increasing transparency in the implementation of EIAs. With the implementation of this strategy, it is hoped that there will be synergies between economic activities and sustainable environmental conservation in Kerinci Regency.

Keywords: Environmental Management, Sand Mining, Tows Strategy

INTRODUCTION

Sand mining activities are one of the activities that are widely found in various regions of Indonesia, especially in areas that have natural resources in the form of rivers or mountainous areas with abundant sand content. The need for sand as the main building material for infrastructure projects makes this activity an important part of the development economic chain. On the one hand, sand mining provides great economic benefits, both for business actors, local workers, and local governments through levies and taxes. But on the other hand, if not managed wisely and sustainably, these activities can have very serious environmental impacts.

This phenomenon occurred in the Siulak Deras area, Gunung Kerinci District, Kerinci Regency. For many years, sand mining activities were carried out intensively around the Cumbadak River and the Tuak River. The two rivers are the main locations for taking sand materials used for local and regional construction needs. However, in recent years, the public and the government have begun to feel the significant negative impact of these activities. The river becomes shallow, the water becomes cloudy, the river current changes direction, and erosion occurs on the river bank. The damage not only impacts aquatic ecosystems, but also on the surrounding infrastructure, such as bridges and roads, as well as on the livelihoods of people who depend on rivers.

This problem shows serious weaknesses in environmental management at the local level. The absence of adequate planning, weak supervision of mining practices, and lack of community involvement in the decision-making process make the negative impact of mining activities continue. In many cases, mining activities are carried out without adequate environmental studies, and some of them do not even have official permits. When damage begins to occur, the treatment carried out is reactive and partial, not preventive and systematic.

In the context of environmental management, strategic management theory plays an important role in analyzing the situation and formulating targeted policies. One approach that can be used is a SWOT (Strengths, Weaknesses, Opportunities, Threats) analysis, which aims to identify internal strengths and weaknesses as well as external opportunities and threats in a system. From the results of the analysis, a strategy formulated in the TOWS matrix can be formed, which offers a combination of actions based on these strategic factors. This approach is widely used in the business and government world, including in the natural resource and environmental management sectors. The application of SWOT and TOWS analysis in the context of sand mining in Siulak Deras will assist stakeholders in understanding the actual conditions and choosing the most appropriate strategy to implement. For example, if the internal weakness is the lack of supervision and the external threat is the increase in illegal mining activities, then a defensive strategy should be devised to strengthen supervision and crack down on violations of the law. On the other hand, if there is strength in the form of high public awareness of environmental sustainability and opportunities for assistance programs from the government, then progressive strategies can be focused on community empowerment and multi-stakeholder collaboration.

This research is important because until now there has been no comprehensive integrated environmental management strategy to overcome the impact of sand mining in the region. The approach used is still sectoral and does not actively involve all parties. In fact, environmental issues are a common problem that must be addressed through cooperation

cross-sectoral and cross-disciplinary. With a data-based strategy and comprehensive analysis, it is hoped that the handling of river damage can be carried out systematically and sustainably.

In addition, another urgent reason is the increasing threat of ecological disasters such as floods and landslides caused by the disturbance of the natural balance due to mining. Shallow rivers and loss of buffer vegetation are particularly vulnerable to overflow during the rainy season. This not only threatens infrastructure, but also the safety of local residents. Therefore, formulating the right environmental management strategy is a very crucial preventive step. The scope of this research includes three main aspects. First, identify and analyze the environmental impact caused by sand mining activities on the physical and ecological conditions of the Cumbadak River and Tuak River. This analysis involves observing changes in river morphology, water quality, and their impact on local biodiversity. Second, evaluating the environmental management conditions implemented by related parties, including local governments, mining business actors, and the community. This evaluation is carried out by reviewing applicable regulations, their implementation in the field, and community participation in the supervision and decision-making process. Third, formulate an effective and applicable environmental management strategy through the SWOT and TOWS approaches, which can be used as a reference for future policies.

In its implementation, this research will use a qualitative approach by collecting data through interviews, field observations, and documentation studies. Information sources include permitting documents, environmental monitoring reports, and other relevant secondary data. The data obtained will be analyzed descriptively and arranged in a SWOT analysis framework to then be derived into a strategy in the form of a TOWS matrix. It is hoped that the results of this research will not only provide academic contributions in the field of environmental management, but also provide practical benefits for stakeholders at the local level. Local governments can use the results of this research as a basis for formulating stricter policies and regulations. Mining business actors can get guidance in implementing more responsible mining practices. The community can get information and insights to play an active role in protecting the surrounding environment.

Overall, this research is an effort to bridge the importance between economic development and environmental conservation. By formulating an environmental management strategy based on local conditions, it is hoped that solutions will be created that are not only technical and administrative, but also social and cultural. These efforts are also in line with the principles of sustainable development that emphasize the balance between current needs and the interests of future generations.

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RESEARCH METHOD

This study uses a descriptive qualitative approach with a case study type. This approach was chosen to gain a deep understanding of the phenomenon of environmental damage due to sand mining, as well as environmental management strategies that can be applied to address it contextually. The case study allows researchers to intensively examine the social, ecological, and institutional dynamics that occur in the Cumbadak River and Tuak River areas, two locations that are significantly affected by mining activities in Gunung Kerinci District, Kerinci Regency, Jambi Province. The research was carried out during the period from May to July 2025, with data collection carried out directly in the field and through documentation studies.

The data sources in this study are divided into two, namely primary data and secondary data. Primary data were obtained through in-depth interviews and field observations. Interviews were conducted with various key informants who were considered to have direct knowledge and experience of the issues being studied, including local communities living around the rivers, representatives of sand mining companies, local government officials such as from the Environment Office, Sub-district Heads, and Village Government officials, as well as representatives from environmental non-governmental organizations (NGOs) and local academics. Interviews are conducted in a semi-structured manner, allowing flexibility in exploring important issues that may arise in the data collection process. In addition, direct observations were made on the physical condition of the river, mining activities, as well as visual impacts such as sedimentation, erosion, and vegetation changes that were visible at the location.

Meanwhile, secondary data is collected from various official documents and relevant written sources. The document includes the Environmental Impact Analysis (EIA) document, the Environmental Management Efforts and Environmental Monitoring Efforts (UKL-UPL) document, as well as environmental permits belonging to sand mining companies operating in the research area. In addition, environmental reports published by local government agencies are also analyzed to gain an understanding of applicable environmental regulations and supervision. Additional data in the form of satellite images, photographic documentation, local media articles, and previous scientific studies were also used as supporting references to strengthen the analysis.

The data obtained was analyzed in stages by applying qualitative analysis techniques. The first step is data reduction, which is the process of selecting, simplifying, and transforming raw data into relevant and meaningful information. In this stage, data that are not directly related to the focus of the research is eliminated, while information showing the relationship between mining activity and environmental damage is filtered and grouped by theme. The second step is data presentation, which is organizing data in the form of descriptive narratives and visualizations such as SWOT tables and TOWS matrices. The goal is to help

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Researchers understand the structure of information thoroughly and systematically, thus facilitating the process of interpretation and strategy formulation.

The next step is the drawing of conclusions and verification, which is carried out through a process of reflection and synthesis of the data that has been analyzed. Researchers identify common patterns or trends from field findings and relate them to relevant environmental management theories or approaches. At this stage, the results of the analysis are compared with previous findings in the literature study, to see the suitability or differences that emerge. The in-depth analysis was conducted using the SWOT (Strengths, Weaknesses, Opportunities, Threats) approach to identify the strengths, weaknesses, opportunities, and threats of the environmental management system applicable in the research site. Then, the results of the SWOT analysis are used to formulate a strategy through the TOWS Matrix, taking into account the most relevant combination of internal and external factors.

RESULT AND DISCUSSION

Findings

Existing Conditions of Sand Mining Activities

Based on the results of field observations, interviews with the surrounding community, and analysis of licensing documents, it was found that sand mining activities in the Cumbadak River and Tuak River areas, Siulak Deras District, Kerinci Regency, took place intensively, even in some cases exceeding the limits of the work area permits. Mining activities are carried out directly in the river body and along the banks of the stream using heavy equipment, without special safeguards against the environmental impacts that may arise. This causes some serious impacts as follows:

- Siltation of the Cumbadak River and Tuak River due to sedimentation
- Erosion of river banks that exacerbate changes in flow
- Water turbidity increases sharply especially during the rainy season
- Fish habitat and other river biota are disturbed
- Deterioration of water quality for agricultural and household needs

Most of the companies that operate have not implemented environmental management plans according to UKL-UPL and AMDAL documents. Supervision by government agencies seems weak, and there is no active community involvement in reporting and supervising mining activities.

SWOT Analysis

The SWOT analysis was conducted based on primary data from interviews and observations as well as secondary data from licensing documents and environmental reports.

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Table 1. SWOT Analysis of Sand Mining Activities in Siulak Deras

Aspect	Description
Strengths (S)	- The existence of AMDAL and UKL-UPL regulations as environmental management instruments - Initial public awareness of environmental impacts is beginning to grow
Weaknesses (W)	- Weak environmental oversight and law enforcement - Lack of community involvement in oversight - Low corporate commitment to the environment - Community economic dependence on the illegal mining sector
Opportunities (O)	Potential for strengthening the role of society through community-based monitoring
Aspects	**Description**
	- Possible use of environmentally friendly technology - Support for local media in raising environmental issues
Threats (T)	- Widespread and permanent environmental damage - Social conflicts between communities and mining actors - Decrease in the carrying capacity of watersheds and water sources for agriculture

Source: Field Data Processing Results (2025)

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TOWS StrategY Formulation

The results of the SWOT analysis are then used to develop an environmental management strategy using the TOWS approach. This strategy includes combining between dimensions to maximize potential and minimize risk.

	Opportunities (O)	**Threats (T)**
Strengths (S)	**SO Strategy** - Optimizing the implementation of AMDAL and UKL-UPL with the support of NGOs/academics - Collaborating with local communities for river conservation programs - Using media influence to	**ST Strategy** - Leveraging environmental regulations to encourage law enforcement against violators - Promoting the river restoration movement as a form of corporate social responsibility
Weaknesses (W)	**WO Strategy** - Increase community capacity through participatory monitoring training - Encourage the adoption of green technologies for more sustainable mining practices	**WT Strategy** - Implementing incentives for environmentally compliant mining companies - Developing a community-based sanctions and reporting system to prevent conflict and permanent damage

Source: SWOT-TOWS Analysis Results (2025))

(Analysis/Discussion

The environmental management strategy resulting from the TOWS formulation leads to five key steps that support each other:

1. **Strengthening Local Institutions** : Supervision of mining activities must actively involve the community and the village government. A community-based reporting system is needed, where residents act as monitoring agents and reporting of mine violations.
2. **Transparency and Accountability** : Information related to AMDAL, UKL-UPL, and Mining permits must be accessible to the public. Thus, the community has a basis to assess the suitability of practices in the field.

3. **River Ecosystem Restoration** : Restoration is not only carried out through dredging of sediments or planting vegetation on the riverbanks, but must also be part of the mining company's CSR program. These responsibilities include the rehabilitation of fish habitats and the control of cliff erosion.
4. **Incentives and Sanctions** : Local governments should develop an incentive system compliance-based. Companies that are proven to implement environmentally friendly mining practices are given fiscal incentives and ease of licensing. On the other hand, a sanction system that involves public reporting will suppress violations.
5. **Environmental Education and Campaigns** : Public campaigns and education are key to the sustainability of the strategy. Community awareness can be formed through schools, village forums, local media, as well as participatory activities such as mutual cooperation and river patrols. This strategy is designed not only to improve ecological conditions, but also to consider the socio-economic conditions of the surrounding community. As stated by Nugroho (2018), a participatory approach in environmental management has been proven to increase the effectiveness and sustainability of programs. In addition, the use of regulatory instruments such as AMDAL should not be purely administrative, but should be a tool for transforming the company's culture towards the environment.

CONCLUSION

Based on the results of the research and analysis that has been carried out, it can be concluded that: Sand mining activities in the Siulak Deras area, especially in the Cumbadak River and Tuak River, have had a significant negative impact on the environment, such as siltation of rivers, cliff erosion, increased water turbidity, and disturbance to aquatic biota habitats. This is exacerbated by the weak management and supervision of mining activities, both legal and illegal. The implementation of environmental management by mining companies and local governments is still ineffective. The EIA and UKL-UPL documents have not been followed by consistent field supervision. Community involvement in environmental supervision is also still low, causing impact control to run suboptimally.

REFERENCES

Alam, J. B., & Mollah, M. A. H. (2013). Environmental impact of sand mining: A case study on the upstream of Meghna River, Bangladesh. *International Journal of Environmental Science and Technology, 10*(1), 123–132. https://doi.org/10.1007/s13762-012-0102-5

Arsyad, S. (2010). *Konservasi tanah dan air* (2nd ed.). IPB Press.

Choudhury, M. I., & Faisal, I. M. (2005). Socio-economic and environmental impact of sand harvesting: A case study from Sariakandi, Bangladesh. *Hydrology Journal, 28*(1), 43–56.

Fitriani, D., & Mustaqim, M. (2020). Implementasi dokumen AMDAL terhadap pengelolaan lingkungan tambang pasir di Kabupaten Sleman. *Jurnal Ilmiah Lingkungan Hidup, 14*(2), 101–109. https://doi.org/10.14710/jilhi.14.2.101-109

Hasibuan, A. N., & Sudrajat, M. A. (2023). Evaluasi efektivitas pelaksanaan UKL-UPL dalam kegiatan pertambangan di daerah aliran sungai. *Jurnal Manajemen Sumberdaya Alam dan Lingkungan, 13*(1), 25–32. https://doi.org/10.22146/jsdal.13.1.25

Kurniawan, T., & Wahyuni, E. S. (2022). Dampak aktivitas pertambangan pasir terhadap kualitas air sungai. *Jurnal Ilmu Lingkungan, 20*(1), 51–60. https://doi.org/10.20885/jil.vol20.iss1.art5

Mulyadi, R., & Siregar, R. M. (2019). Strategi pengelolaan lingkungan berbasis partisipasi masyarakat dalam mengatasi kerusakan sungai. *Jurnal Tata Kelola Lingkungan, 5*(2), 87–
95. https://doi.org/10.31289/jtl.v5i2.345

Putra, H. A., & Maulana, R. (2021). Kajian penerapan prinsip keberlanjutan dalam aktivitas penambangan pasir tradisional. *Jurnal Pembangunan Wilayah dan Kota, 17*(3),
199–208. https://doi.org/10.14710/pwk.v17i3.199-208

Rizal, M., & Dewi, N. F. (2018). Analisis SWOT dan strategi pengelolaan lingkungan tambang rakyat di Sungai Batanghari. *Jurnal Lingkungan dan Pembangunan, 14*(1), 35–
44. https://doi.org/10.22146/jlp.14.1.35

Yulianto, A., & Wulandari, S. (2020). Peran pemerintah daerah dalam pengawasan tambang pasir ilegal: Studi kasus di Kabupaten Kerinci. *Jurnal Hukum & Lingkungan,*
12(2), 115–124. https://doi.org/10.20473/jhl.v12i2.115

Suharyanto, A. (2017). *Analisis SWOT dalam pengelolaan sumber daya alam*. Pustaka Geografi Indonesia.

United Nations Environment Programme. (2019). *Sand and sustainability: Finding new solutions for environmental governance of global sand resources*. https://www.unep.org/resources/report/sand-and-sustainability-finding-new-solutions.