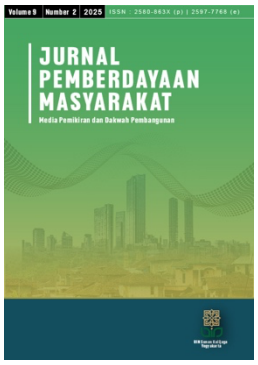

Jurnal Pemberdayaan Masyarakat
Media Pemikiran dan Dakwah Pembangunan

ISSN: (Print) (Online) Journal homepage:
https://ejournal.uin-suka.ac.id/dakwah/JPMI/index

Contesting Legitimacy in Extractive Landscapes: Community Resistance in Indonesia's Sand Mining Conflict

MC Candra Rusmala Dibyorini, **Aulia Widya Sakina**, **Anastasia Adiwirahayu**, **& Umbu Domu Mahani**

To cite this article: MC Candra Rusmala Dibyorini, Aulia Widya Sakina, Anastasia Adiwirahayu, & Umbu Domu Mahani (2025): Contesting Legitimacy in Extractive Landscapes: Community Resistance in Indonesia's Sand Mining Conflict, Jurnal Pemberdayaan Masyarakat: Media Pemikiran dan Dakwah Pembangunan, DOI:10.14421/jpm.2025.092-04

Type of paper: Research article

To link to this article: https://doi.org/10.14421/jpm.2025.092-04

Follow this and additional works at: https://ejournal.uin-suka.ac.id/dakwah/JPMI

Jurnal Pemberdayaan Masyarakat: Media Pemikiran dan Dakwah Pembangunan
https://doi.org/10.14421/jpm.2025.092-04

Contesting Legitimacy in Extractive Landscapes: Community Resistance in Indonesia's Sand Mining Conflict

MC Candra Rusmala Dibyorini[(a)], Aulia Widya Sakina[(a)], Anastasia Adiwirahayu[(a)], and Umbu Domu Mahani[(b)]

[(a)]Sekolah Tinggi Pembangunan Masyarakat Desa APMD Yogyakarta, Indonesia
[(b)]Arizona State University, Arizona, United State

Sand mining has become one of the fastest-growing forms of resource exploitation worldwide, driven by rapid urbanization and infrastructure development. However, its expansion has increasingly generated environmental degradation and social conflicts, particularly in riverine and volcanic landscapes where sand deposits are abundant. This study examines the dynamics of sand mining conflict in the Mount Merapi area, Indonesia, focusing on how contested legitimacy over resource control shapes community resistance and environmental governance. Using a qualitative case study of the Tringsing River, this research draws on in-depth interviews, focus group discussions, field observations, and document analysis to explore interactions among local communities, mining actors, and government authorities. The findings reveal that sand mining conflicts are not merely disputes over economic resources but reflect broader struggles over the legitimacy of governance institutions and environmental stewardship. Local communities from Sewukan, Sengi, and Paten mobilized collective resistance through the Trimanunggal Inter-Village Cooperation Agency (BKAD), which functions as a community-based environmental governance institution. Meanwhile, fragmented regulatory arrangements and overlapping authorities have weakened enforcement and complicated conflict resolution. This study highlights that grassroots resistance represents an alternative form of environmental governance and emphasizes the need for stronger institutional coordination and recognition of community-based actors.

ARTICLE HISTORY
Received 06 August 2024
Accepted 30 December 2025

KEYWORDS
Sand mining conflict; contested legitimacy; community-based environmental governance; community resistance; Merapi Area

Introduction

Environmental conflicts have increasingly become a critical issue in the pursuit of sustainable development, particularly in areas where economic growth depends heavily on natural resource extraction. These conflicts often emerge when governments, private companies, and local communities compete over access to environmental resources that

CONTACT MC Candra Rusmala Dibyorini candrarusmaladibyorini@gmail.com Sekolah Tinggi Pembangunan Masyarakat Desa APMD Yogyakarta, Indonesia, Jalan Timoho No. 317 Yogyakarta, Indonesia 55225

simultaneously possess economic, ecological, and social value (Zografos et al., 2020). In many developing countries, rapid infrastructure expansion and urban development have intensified the exploitation of natural resources, frequently triggering conflicts related to environmental governance and community livelihoods.

Environmental conflict theory suggests that such conflicts rarely arise solely from resource scarcity. Rather, they are shaped by governance failures, unequal power relations, and institutional arrangements that determine how environmental resources are distributed among stakeholders (Peluso & Watts, 2001). Environmental conflicts therefore represent broader struggles over environmental justice, development priorities, and social welfare. While development actors often frame resource extraction as an engine of economic growth, local communities frequently experience it as a threat to ecological sustainability and livelihood security.

Recent global studies demonstrate that environmental conflicts related to extractive industries are increasingly widespread. A large-scale analysis of more than 2,700 environmental conflicts worldwide shows that grassroots mobilization by local communities has become a crucial mechanism for defending environmental resources and promoting more sustainable development pathways (Scheidel et al., 2020). These conflicts highlight the unequal distribution of environmental benefits and burdens, where communities often bear the ecological costs of resource extraction while receiving limited economic benefits.One sector that illustrates these tensions clearly is sand mining, which has become a crucial resource for the global construction industry. Rapid urbanization and infrastructure expansion have significantly increased global demand for sand, making it one of the most extracted natural resources in the world (Peduzzi, 2014). However, unsustainable sand extraction has generated significant environmental impacts, including riverbank erosion, habitat destruction, groundwater depletion, and increased flood risks (Koehnken & Rintoul, 2018).

Recent research suggests that the extraction of river sand has become a global governance challenge due to weak regulatory frameworks and inadequate institutional coordination in managing sand resources (Duker et al., 2023). Studies show that failures in sand governance have contributed to increasing environmental degradation and social conflicts in river ecosystems across many areas (Yasmin & Clark, 2024). In many cases, these conflicts emerge when economic interests related to construction and infrastructure development collide with the environmental functions of river ecosystems that sustain agricultural livelihoods. In Southeast Asia, the rapid expansion of infrastructure development has intensified the exploitation of river sediments, generating numerous environmental conflicts across the area. Research indicates that sand mining has become a significant driver of environmental degradation and social tensions, particularly in rural areas where communities depend heavily on river ecosystems for water supply and agriculture (Marschke & Rousseau, 2022). These conflicts reveal fundamental challenges in balancing economic development with environmental sustainability and social equity.

Indonesia provides an important context for examining such dynamics. As a country rich in natural resources and undergoing rapid economic transformation, Indonesia has experienced increasing environmental conflicts associated with extractive industries, including mining, forestry, and plantation development (Leal Filho & Azul, 2021). Weak regulatory enforcement, overlapping institutional authority, and limited community participation in decision-making processes have often exacerbated these conflicts.

One area where these dynamics are particularly visible is the Mount Mount Merapi area in Central Java. Mount Merapi is one of the most active volcanoes in the world and continuously produces large quantities of volcanic sediment that accumulate along surrounding river channels. These sand deposits have become valuable construction materials widely used in regional infrastructure development (Widianto, 2019). Consequently, sand mining has become an important economic activity in the Merapi area, attracting both local miners and large-scale investors.

However, the expansion of sand mining activities in the Merapi area has also generated significant environmental and social challenges. Intensive sand extraction has been shown to damage river ecosystems, reduce water availability for irrigation, and increase ecological vulnerability in surrounding agricultural areas (Yudhistira et al., 2011). These environmental impacts have frequently triggered conflicts between mining companies, government institutions, and local communities who depend on river ecosystems for agricultural livelihoods. Previous research on sand mining conflicts in the Merapi area has largely focused on institutional governance and conflicts between mining actors. Limited attention has been given to how community-based resistance movements contribute to conflict resolution. Recent studies suggest that community mobilization against extractive industries should not be understood merely as opposition to development, but rather as a form of community environmental governance that can influence environmental policy and promote sustainable resource management (Martinez-Alier et al., 2016; Tran & Hanaček, 2023).

The sand mining conflict occurring in the Tringsing River area in Dukun District, Magelang Regency represents an important case for examining these dynamics. Unlike many other rivers in the Merapi area that have been heavily exploited by mechanized mining operations, the Tringsing River remains relatively natural and continues to function as an important source of irrigation and water supply for surrounding communities. However, the emergence of mining permits issued to several companies planning mechanized sand extraction in the area has triggered strong resistance from local communities. Residents fear that mining activities could damage irrigation systems, reduce spring water discharge, and threaten the sustainability of local agricultural livelihoods. In response, communities from the villages of Paten, Sewukan, and Sengi have organized collective resistance through the establishment of the Trimanunggal Inter-Village Cooperation Agency (BKAD Trimanunggal).

Building on environmental conflict theory and community-based governance perspectives, this study argues that local resistance movements can function as important

mechanisms of environmental governance by shaping negotiation processes, influencing policy responses, and promoting more sustainable management of natural resources. Rather than merely opposing development initiatives, community mobilization may serve as a catalyst for redefining resource governance arrangements that better reflect local ecological needs and social justice concerns. Conflicts over sand mining in the Merapi Area are therefore not only disputes over resource extraction but also reflect competing claims of legitimacy regarding who has the authority to govern riverine resources.

To address this gap, this study investigates the sand mining conflict occurring in the Tringsing River area in Dukun District, Magelang Regency. Specifically, the study seeks to answer the following research questions: (1) How did the sand mining conflict in the Tringsing River area emerge and evolve over time?; (2) How do community-based resistance movements contribute to conflict resolution and environmental governance in the context of sand mining? The contribution of this study is threefold. First, it expands the literature on environmental conflict by examining sand mining conflicts within the broader framework of environmental governance and social development. Second, it provides an empirical analysis of how community-based collective action influences conflict resolution processes in resource extraction conflicts. Third, by analyzing the Tringsing River case, this research offers insights into how grassroots environmental movements can contribute to more sustainable and socially inclusive approaches to natural resource governance in developing countries.

Literature Review

State of the Art: Environmental Conflicts in Resource Extraction

Environmental conflicts have become an increasingly important subject in studies of natural resource governance and sustainable development. These conflicts arise when economic development activities intersect with environmental sustainability and local livelihoods, generating competing claims over the control and use of natural resources (Scheidel et al., 2020). Rather than representing purely technical conflicts over environmental management, environmental conflicts often reflect deeper structural tensions related to power relations, institutional arrangements, and unequal access to environmental benefits (Martinez-Alier et al., 2016).

In recent decades, extractive industries have been recognized as a major source of environmental conflict across many areas of the world. Resource extraction projects frequently generate environmental degradation while the economic benefits are unevenly distributed among stakeholders, leading to social resistance and collective mobilization by affected communities (Bebbington et al., 2018). These conflicts are increasingly understood within the framework of environmental justice, which emphasizes the unequal distribution of environmental risks and benefits among social groups (Zografos et al., 2020).

Within this broader debate, sand mining has emerged as a particularly significant environmental governance challenge. Sand is one of the most extracted natural resources

globally, primarily due to its importance in the construction and infrastructure sectors (Peduzzi, 2014). Rapid urbanization and infrastructure development have dramatically increased global demand for sand, placing significant pressure on river ecosystems and coastal environments (Leal Filho & Azul, 2021). However, sand extraction is often poorly regulated, leading to environmental degradation and increasing the potential for conflicts between mining operators and local communities.

Research has shown that uncontrolled sand mining can produce severe ecological impacts, including riverbank erosion, groundwater depletion, biodiversity loss, and increased vulnerability to flooding (Koehnken & Rintoul, 2018). These environmental consequences frequently affect rural communities that depend on river ecosystems for agriculture, water supply, and local livelihoods. Recent scholarship highlights that sand mining conflicts are not merely environmental conflicts but also governance challenges involving multiple actors and competing interests (Marschke & Rousseau, 2022). Weak regulatory frameworks, fragmented institutional authority, and limited monitoring capacity often allow sand extraction to proceed without adequate environmental oversight (Duker et al., 2023). These governance failures frequently generate tensions between government institutions, mining companies, and local communities.

Globally, environmental conflicts related to mining activities have also been linked to broader political and economic dynamics. Studies show that extractive development often occurs within governance systems characterized by power asymmetries, where state institutions and corporate actors possess greater influence over resource management decisions than local communities (Geenen & Verbrugge, 2021). Such asymmetries frequently contribute to the marginalization of local communities in environmental decision-making processes, increasing the likelihood of conflict. Recent research suggests that community resistance movements play a crucial role in shaping environmental governance outcomes. Grassroots mobilization can challenge extractive development projects, influence policy decisions, and promote more sustainable resource management practices (Tran & Hanaček, 2023). In many cases, environmental conflicts serve as arenas where communities contest dominant development models and advocate alternative approaches to resource governance.

Sand Mining Conflicts

In Southeast Asia, sand mining conflicts have become increasingly prominent due to rapid infrastructure development and urban expansion. Several studies indicate that the extraction of river sediments has intensified significantly in recent decades, generating environmental degradation and social tensions in many rural areas (Marschke & Rousseau, 2022). These conflicts often emerge when communities perceive that sand mining activities threaten local ecosystems and agricultural livelihoods. In many cases, local communities rely heavily on river ecosystems for irrigation, fisheries, and domestic water supply. When sand extraction disrupts these ecological functions, communities frequently mobilize collective action to resist mining operations.

Studies on sand mining governance in the area highlight the role of institutional weaknesses in exacerbating these conflicts. Regulatory frameworks governing sand extraction are often fragmented across multiple agencies, leading to overlapping authority and inconsistent enforcement (Yasmin & Clark, 2024). Limited transparency in licensing procedures and inadequate monitoring mechanisms further contribute to public distrust toward government institutions.

Indonesia represents a particularly relevant context for examining environmental conflicts associated with extractive industries. As a resource-rich country undergoing rapid economic transformation, Indonesia has experienced increasing conflicts related to mining, plantation expansion, and infrastructure development (Leal Filho & Azul, 2021). Environmental conflicts in Indonesia are frequently shaped by governance challenges such as weak regulatory enforcement, overlapping institutional authority, and limited community participation in decision-making processes (Hajer & Versteeg, 2019). These institutional weaknesses often create conditions in which extractive activities can proceed despite strong local opposition.

Within Indonesia, the Mount Merapi area in Central Java provides a particularly relevant case for studying sand mining conflicts. Mount Merapi continuously produces volcanic sediment that accumulates in surrounding river systems. These deposits have become valuable construction materials widely used in infrastructure development across Java. As a result, sand mining has become an important economic activity for communities living around the Merapi area. However, the expansion of sand extraction has also generated environmental and social tensions, particularly when mechanized mining techniques threaten river ecosystems and local agricultural systems.

Several studies have examined sand mining conflicts in the Mount Merapi area. (Sulaksono & Hadiyan, 2015) analyzed conflict resolution strategies related to sand extraction within the Mount Merapi National Park area. Their research emphasizes the role of government institutions in mediating conflicts among stakeholders. Similarly, (Varhan & Taufiq, 2019) examined the role of labor organizations in mediating conflicts between manual sand miners and mechanized mining operators. Their study demonstrates that collective organization among miners can reduce tensions between competing actors within the mining sector. Another study conducted by (Rizki & Putranto, 2018) evaluated the effectiveness of conflict resolution mechanisms in the Progo River watershed area. Their research highlights weaknesses in the implementation of conflict resolution policies, particularly in relation to planning coordination and administrative transparency.

Despite these important contributions, existing studies on sand mining conflicts in the Merapi area remain limited in several respects. First, most research focuses primarily on institutional governance challenges and regulatory issues. Second, previous studies often examine conflicts among mining actors rather than conflicts between mining operators and local communities. Third, relatively little attention has been given to understanding how community-based resistance movements influence conflict dynamics

and conflict resolution processes. To address these gaps, this study examines the sand mining conflict in the Tringsing River area in Magelang Regency by analyzing the chronology of the conflict, mapping the actors involved, and examining how community-based resistance movements influence conflict resolution processes.

Social Movements and Community Resistance

Social movement theory provides a crucial analytical framework for understanding how communities mobilize collective action in response to environmental conflicts. Social movements are generally conceptualized as networks of informal interactions among individuals, groups, and organizations that share collective grievances and mobilize resources to pursue social and political change (Della Porta & Diani, 2006). Within environmental governance contexts, social movements frequently emerge when local communities perceive that institutional arrangements fail to protect environmental rights, local livelihoods, and equitable access to natural resources (Martinez-Alier et al., 2016; Zografos et al., 2020). Consequently, grassroots mobilization often becomes a strategic response through which communities contest extractive activities and advocate for more sustainable and socially just resource management practices.

Environmental conflicts often act as catalysts for the emergence of community resistance movements. Research on environmental justice movements demonstrates that conflicts over natural resource extraction frequently arise from unequal distribution of environmental costs and benefits (Geenen & Verbrugge, 2021), where marginalized communities disproportionately bear ecological risks while receiving limited economic gains (Martinez-Alier et al., 2016; Scheidel et al., 2020). In this context, environmental conflicts represent not only ecological conflicts but also socio-political struggles involving power relations, rights to natural resources, and competing visions of development (Martinez-Alier et al., 2016). As a result, local communities increasingly mobilize resistance to challenge development policies that prioritize economic growth at the expense of environmental sustainability and community well-being.

A key element in the emergence of social movements is the formation of collective identities among affected communities. Collective identity enables individuals to transform personal grievances into shared social concerns, thereby facilitating participation in collective action (Della Porta & Diani, 2006). Environmental conflicts often accelerate this process by creating a shared perception of environmental threats that affect community livelihoods and ecological security. Through collective identity formation, communities develop solidarity and shared commitments to protect natural resources and resist environmentally harmful practices.

Grassroots environmental movements frequently rely on informal networks and community solidarity to mobilize resistance against extractive activities. These informal networks allow communities to exchange information, coordinate collective actions, and build alliances with civil society organizations and environmental advocacy groups (Martinez-Alier et al., 2016). Such alliances often strengthen the capacity of local communities to challenge powerful actors involved in natural resource extraction,

including corporations and state institutions (Bebbington et al., 2018; Geenen & Verbrugge, 2021). In many cases, environmental conflicts evolve into broader political struggles that question the legitimacy of existing governance institutions and demand greater accountability in environmental decision-making (Hajer & Versteeg, 2019).

Recent research highlights the growing role of environmental defenders and grassroots mobilization in shaping environmental governance outcomes. Environmental defenders play a significant role in raising awareness about environmental degradation, advocating policy reforms, and promoting alternative development pathways that prioritize ecological sustainability and social justice (Scheidel et al., 2020; Tran & Hanaček, 2023). These actors often operate within broader transnational networks that connect local environmental struggles with global environmental justice movements (Martinez-Alier et al., 2016). Through such networks, community resistance movements are able to amplify their voices and influence policy debates beyond local contexts.

Furthermore, social movements play an important role in promoting more participatory forms of environmental governance. Community resistance movements frequently advocate greater transparency, accountability, and public participation in natural resource management processes (Zografos et al., 2020). These mobilizations demonstrate that social movements not only function as mechanisms of protest but also serve as platforms for proposing alternative governance arrangements that prioritize environmental protection and social equity (Bebbington et al., 2018). In this sense, community resistance movements contribute to the democratization of environmental governance.

Therefore, analyzing social movements and community resistance is essential for understanding the dynamics of environmental conflicts and their potential resolution. Social movement theory provides valuable insights into how communities organize collective action, construct shared identities, and mobilize resistance against environmentally destructive practices. By examining these dynamics, scholars can better understand how grassroots mobilization shapes environmental governance processes and contributes to broader struggles for environmental justice and sustainable resource management (Martinez-Alier et al., 2016; Scheidel et al., 2020).

While social movement theory helps explain how communities mobilize collective resistance against environmental degradation, understanding the dynamics of these mobilizations also requires analytical tools capable of examining how conflicts emerge, escalate, and evolve over time. In this regard, conflict analysis frameworks provide a useful perspective for identifying the underlying causes of conflicts, the relationships among actors, and the structural tensions that shape conflict processes in environmental governance.

Theoretical Frameworks for Conflict Analysis

Understanding environmental conflicts requires analytical frameworks capable of examining the structural dimensions of conflict. One widely used framework is the conflict

triangle developed by Johan Galtung, which conceptualizes conflict as an interaction among attitudes, behaviors, and context contradiction (Galtung, 1996). Attitudes refer to the perceptions and emotions held by actors involved in the conflict. Behaviors describe the actions taken by these actors, including protest, negotiation, or confrontation. Contradictions refer to the underlying structural conditions that generate conflict, such as unequal access to resources. So between attitudes, behaviors, and contexts, these will continue to alternate and give birth to social problems.

Conflict analysis tools such as conflict mapping and conflict chronology are frequently used to examine how conflicts evolve over time and how relationships among actors change during different stages of conflict (Fisher et al., 2001). Conflict analysis can be done by looking at conflict chronology, conflict staging, and conflict mapping. From a conflict resolution perspective, Galtung identifies three main stages: peacemaking, peacekeeping, and peacebuilding. Peacemaking focuses on dialogue and negotiation between conflicting actors. Peacekeeping involves maintaining stability following an agreement. Peacebuilding seeks to address structural inequalities and create long-term conditions for sustainable peace (Galtung, 1996). Recent research highlights the importance of participatory governance in conflict resolution processes. Inclusive decision-making mechanisms that involve local communities can help address the underlying causes of environmental conflicts and promote more sustainable resource governance (Bui, 2023). Building on these debates, this study draws on environmental conflict analysis and social movement theory to examine how community-based resistance shapes conflict dynamics and influences environmental governance in sand mining conflicts.

Historical Context of Sand Mining in the Merapi Area

Understanding the dynamics of sand mining conflicts in the Mount Merapi Area requires examining the historical development of sand extraction activities and the changing relationships between communities, economic actors, and river ecosystems. Over time, sand mining in this region has evolved from a small-scale livelihood activity into a complex socio-environmental issue involving competing economic interests, shifting livelihood strategies, and environmental governance challenges (Peduzzi, 2014; Torres et al., 2017).

Sand mining activities in Magelang Regency can be traced back to the 1970s, when local communities living along rivers originating from Mount Merapi began extracting sand manually from riverbeds. These activities relied on simple tools such as hoes, crowbars, sieves, and slenggrong, a traditional carrying device commonly used by villagers. Because the extraction process depended largely on manual labor, the workers involved were widely known as manual sand miners. At that time, sand mining functioned primarily as a supplementary livelihood for rural communities and was carried out on a relatively small scale.

Over time, however, the demand for sand increased significantly as it became a fundamental material for housing construction and infrastructure development. This growing demand attracted entrepreneurs and investors from both within and outside

Magelang Regency. Unlike local miners who relied on manual techniques, these investors introduced mechanized mining practices using heavy equipment such as backhoes and excavators. The introduction of mechanized extraction technologies accelerated the rate of sand extraction and significantly expanded the scale of mining operations across river systems surrounding Merapi.

As sand deposits in downstream river areas gradually declined, mining activities began moving upstream toward the slopes of Mount Merapi in search of new material sources. This expansion intensified competition over access to sand resources and gradually altered the governance of river ecosystems in the region. A major turning point in the dynamics of sand mining occurred following the eruption of Mount Merapi in October-November 2010, one of the most significant volcanic events in Indonesia in recent decades (Surono et al., 2012). The eruption released an estimated 150 million cubic meters of volcanic material, far exceeding the approximately 8 million cubic meters produced by the 2006 eruption. Large volumes of volcanic debris, including sand and rocks, were transported downstream through rivers originating from Merapi, particularly during the rainy season when lahar floods carried sediment along river channels (Charbonnier et al., 2013). As a result, substantial deposits of sand accumulated along river systems surrounding the volcano.

In response to the accumulation of volcanic sediment, the government introduced river normalization programs aimed at restoring the hydrological and ecological functions of affected rivers. These programs also created new opportunities for sand extraction, as large volumes of volcanic material became available for commercial use. Consequently, sand mining activities intensified rapidly following the eruption, often involving deep excavation of riverbeds and the widespread use of heavy machinery. According to the Serayu-Opak River Basin Authority (Balai Besar Wilayah Sungai Serayu-Opak), sediment retention structures built around the Merapi area were originally designed to control lahar flows and protect downstream areas from volcanic hazards. However, uncontrolled sand mining activities have gradually contributed to the ecological degradation of these structures, often ignoring technical recommendations and environmental regulations (Otani & Suharyanto, 2013; Prayoga et al., 2024). In this context, sand mining has not only generated ecological impacts but has also contributed to governance challenges and regulatory violations.

Conflicts over natural resource management in the Merapi Area have a long historical trajectory. Historical records indicate that disputes over the regulation and control of the Merapi area can be traced back to 1912, when the Dutch colonial government began formalizing policies governing the region (Kuswijayanti et al., 2007). Since then, various forms of conflict have emerged related to land use, conservation policies, and resource extraction. Contemporary sand mining conflicts can therefore be understood as part of a broader historical process in which competing interests over resource control have persisted across different political and economic periods.

The 2010 eruption also triggered significant changes in local livelihood structures. Many agricultural lands along rivers were buried under thick layers of volcanic material, making them unsuitable for cultivation (Widati et al., 2021). As a result, some residents began collecting and transporting sand and rocks from former agricultural land and riverbeds, gradually shifting their livelihoods from farming to sand extraction. At the same time, the abundance of sand deposits attracted larger investors who introduced mechanized mining operations supported by modern transportation systems. As downstream deposits became increasingly depleted, mining activities expanded further upstream, intensifying competition among different actors seeking access to sand resources.

These developments have reshaped the social and economic dynamics of communities living on the slopes of Merapi. Competition between manual miners, mechanized mining operators, local residents, and external investors has generated new social tensions. In many cases, multiple actors operate within the same geographical space without clearly defined access rights or regulatory boundaries. Such conditions often result in unequal distribution of economic benefits while simultaneously producing environmental degradation, as actors prioritize short-term economic gains over long-term ecological sustainability (Kondolf et al., 2014).

One example of such tensions can be observed in the Tringsing River area in Dukun District, Magelang Regency. Since the early 2000s, several mining companies have approached local communities seeking permission to conduct sand mining activities along the river. These proposals have been repeatedly rejected by residents who fear that mechanized mining would damage the river ecosystem and threaten local environmental sustainability. Despite these refusals, companies have continued attempting to gain access through various strategies, including framing mining activities as part of river normalization programs. These historical developments illustrate how environmental change, economic interests, and shifting livelihood strategies have gradually reshaped the governance of river resources in the Merapi Area. The expansion of mechanized mining, combined with weak regulatory oversight and increasing competition over sand deposits, has intensified tensions among actors operating within the same ecological space.

Method

This study adopts a qualitative research design with an exploratory case study approach to examine the dynamics of the sand mining conflict in the Tringsing River area of Magelang Regency, Central Java, Indonesia. A qualitative approach is particularly appropriate for investigating complex social phenomena such as environmental conflicts because it enables researchers to explore actors' perspectives, social interactions, and contextual dynamics that shape conflict processes (Creswell & Creswell, 2020; Flick, 2022). Environmental conflicts often involve multiple stakeholders, competing interests, and diverse interpretations of environmental risks, making qualitative inquiry especially suitable for capturing the complexity of such situations (Creswell & Poth, 2018).

The exploratory case study approach was chosen to obtain an in-depth understanding of the Merapi sand mining conflict, which remains unresolved and continues to generate tensions between local communities, mining actors, and government institutions. Case study research allows researchers to investigate contemporary social phenomena within their real-life contexts and to analyze the interactions between actors, institutions, and environmental governance processes (Yin, 2018). In this research, the case study approach enables the examination of the chronology of the conflict, the identification of key actors involved in the conflict, and the exploration of potential strategies for conflict resolution related to sand mining activities in the Tringsing River area. The analytical orientation of the study is also informed by perspectives from environmental conflict research that emphasize the importance of understanding actor relationships, community resistance, and governance responses in shaping environmental conflicts (Martinez-Alier et al., 2016; Scheidel et al., 2020).

The study was conducted in three villages located in Dukun District, Magelang Regency, namely Paten, Sewukan, and Sengi villages. These villages are situated near the Tringsing River, which originates from Mount Merapi and functions as an important water source supporting irrigation systems and agricultural activities in the surrounding areas. The research sites were selected purposively because they represent communities directly affected by the sand mining conflict. In recent years, local residents in these villages have expressed strong opposition to mechanical sand mining activities due to concerns about environmental degradation, damage to irrigation infrastructure, and the potential decline of water sources that support local livelihoods. The case therefore provides an important context for understanding how environmental conflicts emerge and how communities mobilize collective resistance to protect their environmental resources.

Data for this study consist of both primary and secondary data sources (Harahap, 2020; Sugiyono, 2021). Primary data were obtained through field observations, in-depth interviews, and focus group discussions (FGDs) conducted in stages during the research process. Field observations were carried out in Paten, Sewukan, and Sengi villages to understand the socio-environmental context of the conflict and to observe the physical conditions of the Tringsing River area. Observations allowed the researcher to examine community activities related to sand mining as well as the environmental conditions that have become the subject of local concern. These observations also provided contextual insights into how the conflict affects everyday social and economic activities in the affected communities.

In-depth interviews were conducted with key informants who possess relevant knowledge and experience regarding the ongoing conflict. Informants were selected using purposive sampling, a common strategy in qualitative research for identifying participants who are directly involved in or affected by the phenomenon being studied (Palinkas et al., 2015). The interview participants included community leaders, village officials such as village heads and hamlet leaders, neighborhood leaders, leaders of community

organizations, and representatives of local residents who oppose sand mining activities. In addition, interviews were conducted with representatives from relevant government institutions, including the Serayu-Opak River Basin Agency (Balai Besar Wilayah Sungai Serayu-Opak) and the Civil Service Police Unit (Satpol PP) of Magelang Regency. These interviews provided insights into different perspectives on the causes of the conflict, the roles of various stakeholders, and the responses of government authorities to the conflict.

Focus group discussions were also conducted with community members to facilitate collective discussions about the sand mining conflict. FGDs allow participants to share experiences, debate perspectives, and collectively interpret the causes and consequences of environmental conflicts (Morgan, 2019). Through group discussions, the researcher was able to capture community perceptions regarding environmental risks, governance issues, and possible pathways for conflict resolution. The FGDs also provided opportunities for participants to reflect collectively on the history of the conflict and the strategies that communities have adopted in resisting sand mining activities.

Secondary data were obtained through document analysis, including academic journal publications, reference books related to social conflict and conflict resolution, government policies and regulations on sand mining, maps of mining activities, and reports from seminars or workshops related to environmental governance. These documents were used to provide contextual information about the institutional and regulatory framework governing sand mining activities in the area as well as to support the interpretation of field data.

The collected data were analyzed using interactive qualitative data analysis techniques as proposed by Miles, Huberman, and Saldaña (2019) (Miles et al., 2019). This analytical approach involves three interrelated processes: data condensation, data display, and conclusion drawing and verification. Data condensation refers to the process of selecting and organizing relevant information from interviews, observations, FGDs, and documents. Data display involves presenting the data in structured forms such as thematic categories, matrices, or conceptual diagrams to facilitate interpretation. Finally, conclusion drawing and verification involve identifying patterns and relationships in the data while continuously checking the validity of the interpretations. In addition to this interactive analysis model, thematic analysis was applied to identify key themes related to environmental conflict dynamics, community resistance, and conflict resolution strategies (Braun & Clarke, 2021).

To ensure the credibility and trustworthiness of the research findings, several strategies commonly used in qualitative research were applied. First, data triangulation was conducted by comparing information obtained from multiple sources, including interviews, observations, FGDs, and document analysis. Triangulation enables researchers to validate findings by examining whether different sources provide consistent interpretations of the same phenomenon (Lincoln & Guba, 1985). Second, methodological triangulation was employed by combining different data collection methods in order to strengthen the robustness of the analysis (Flick, 2022). Finally, member checking was conducted by discussing preliminary interpretations with selected

participants to ensure that the findings accurately reflected their experiences and perspectives. Through these procedures, the research aims to produce credible and rigorous qualitative insights into the dynamics of the sand mining conflict in the Tringsing River area.

Results

Conflict Chronology

Pre-conflict: Emerging Concerns over Sand Mining

The Tringsing River area, located in the upper reaches of the Mount Mount Merapi Area in Magelang Regency, became the center of social tension following plans for sand mining activities. The pre-conflict stage emerged when several companies initiated exploration and river "normalization" plans using heavy equipment along the Tringsing River. These activities immediately triggered concerns among local communities because the river represents one of the few remaining natural water sources in the upper Merapi landscape.

For communities living on the slopes of Mount Merapi, the Tringsing River functions not only as a natural ecosystem but also as a crucial source of livelihood. Local agriculture heavily depends on water originating from the river and its associated springs. According to local authorities in Sewukan Village, approximately 155 hectares of agricultural land rely on irrigation systems connected to the Tringsing River, while at least 31 springs provide water for both domestic consumption and agricultural activities. Representatives of farmer groups in Sengi Village similarly emphasized that the river has historically guaranteed stable water availability for the surrounding communities. During the dry season, water from the Tringsing River is even distributed to neighboring districts such as Borobudur and Salaman to address seasonal water shortages.

Concerns over environmental degradation and water scarcity prompted communities from three villages (Sewukan, Sengi, and Paten) to raise objections to the planned mining activities. Representatives from these villages approached the Environmental Office of Central Java Province to express their concerns regarding the potential environmental and social impacts of sand extraction in the upstream river system. For many residents, protection of Tringsing River was considered essential to sustaining agricultural livelihoods and maintaining ecological balance of Merapi watershed.

The conflict intensified when communities discovered that the Tringsing River had been designated as part of a mining zone within regional spatial planning documents. This designation created institutional constraints because removing the river from the mining map would require a lengthy bureaucratic process involving the Public Works and Spatial Planning Office of Magelang Regency. The classification of the river as a mining zone thus created a governance dilemma between environmental protection and extractive economic interests.

At the same time, uncertainty surrounding the mining licensing process further aggravated the situation. Residents reported that companies had begun preparing for

mining activities even though the status of their operational permits remained unclear. According to data from the Minerba One Map Indonesia (MOMI) system, two companies had obtained exploration Mining Business Licenses (IUP), while another company held a Mining Business License Area (WIUP). However, local communities claimed that they had never received official notification or consultation from the companies involved. This lack of transparency contributed to growing distrust toward both corporate actors and government institutions responsible for regulating mining activities.

Additional controversy emerged when a map of mining locations circulated among local residents. The proposed mining sites were reportedly located close to a sabo dam structure, raising concerns about regulatory violations. Indonesian regulations require a minimum distance between mining sites and sabo dam infrastructure to ensure river stability and disaster mitigation. Moreover, mining activities in river areas require technical recommendations from the river basin authority. However, the Serayu-Opak River Basin Agency stated that it had never issued any technical recommendation for sand mining activities in the Tringsing River. This regulatory inconsistency further reinforced community suspicion regarding the legitimacy of the proposed mining operations.

Confrontation: Community Mobilization and Institutional Responses

As tensions escalated, the conflict moved from a latent stage to open confrontation between local communities and actors supporting sand mining activities. Although each of the three villages had previously established village regulations prohibiting mining activities in their territories, these rules gradually became difficult to enforce due to overlapping authorities and external economic interests. In response, the communities of Sewukan, Sengi, and Paten initiated the formation of an inter-village organization known as the Trimanunggal Inter-Village Cooperation Agency (BKAD). This institution served as a collective platform through which communities coordinated their resistance to mining activities and articulated their demands to government authorities.

Through BKAD Trimanunggal, residents sought to strengthen cooperation among the three villages in protecting the Tringsing River from large-scale sand extraction. Community leaders emphasized that the increasing scarcity of sand deposits in other rivers around Mount Merapi had made the relatively untouched Tringsing River an attractive target for mining companies. This situation raised concerns that intensive mining could damage water catchment areas in the upper watershed and threaten groundwater availability for surrounding communities.

While local communities strengthened their collective resistance, government institutions presented a different perspective. Officials from the Energy and Mineral Resources Office (ESDM) of Central Java Province acknowledged the potential environmental risks associated with sand mining but argued that material extraction was sometimes necessary for river normalization and disaster mitigation. Similarly, the Environmental Office of Magelang Regency explained that the spatial planning

framework regulating the Merapi area allows certain forms of river material extraction within designated zones. This institutional perspective created a fundamental disagreement between local communities and government authorities. For residents, sand mining represented a direct threat to water security and environmental sustainability. For government agencies, however, mining activities were framed as part of broader river management and disaster mitigation strategies in volcanic environments.

Escalation: Intimidation and Social Tension

As resistance intensified, the conflict entered a more critical stage marked by rising tensions and increasing pressure on local communities. Various forms of protest were organized by residents through BKAD Trimanunggal, including the installation of banners rejecting mechanical mining and the mobilization of community members to prevent mining equipment from entering the river area. At the same time, several mining companies reportedly attempted to approach local residents to purchase land surrounding the river. According to community representatives, some residents were offered advance payments as part of efforts to secure land for mining operations. These approaches created anxiety among villagers, particularly when negotiations were accompanied by perceived intimidation and threats of legal action if residents refused to release their land.

The escalating tensions also began to affect social relations within the community. Some residents feared that continued pressure from mining actors could trigger internal divisions or even violent confrontation. As a result, community members sought protection from the Magelang Regency Police while continuing to pursue institutional channels to challenge the mining plans. Following consultations with local authorities, community representatives were eventually directed to the Serayu-Opak River Basin Agency, which holds jurisdiction over river management in the region. During meetings involving multiple government agencies, it became evident that there were inconsistencies in communication regarding the mining plans. Importantly, the river basin authority reaffirmed that it had never issued technical recommendations for sand mining in the Tringsing River. This statement strengthened the position of local communities in questioning the legality of the proposed mining activities.

Immediate Outcomes of the Conflict

Despite the complexity of the regulatory framework governing mining activities, communities in Sewukan, Sengi, and Paten continued to mobilize collective resistance to protect the Tringsing River. For local residents, environmental conservation was inseparable from the protection of their social and economic livelihoods. Community members repeatedly emphasized that sand mining in the Tringsing River was no longer perceived as a form of river management but rather as a commercial activity driven by extractive economic interests. In their view, the increasing commercialization of sand resources in the Merapi Area has shifted mining practices away from disaster mitigation toward profit-oriented exploitation.

Consequently, the conflict over sand mining in the Tringsing River reflects broader tensions between environmental protection, local livelihoods, and extractive economic activities in the Merapi Area. While government institutions continue to emphasize regulatory and technical considerations, local communities frame the issue primarily as a struggle to defend vital water resources and protect the ecological sustainability of their environment.

Conflict Mapping of Sand Mining in the Tringsing River

Conflict mapping is used to identify the key actors involved in the sand mining conflict and to understand their respective interests, roles, and relationships. Mapping these actors helps explain how competing interests shape the dynamics of environmental conflict in the Tringsing River area, located in the upper watershed of Mount Merapi in Magelang Regency. Based on field observations and interviews, the conflict involves at least six major actors: (1) the village governments of Sewukan, Sengi, and Paten represented through the Trimanunggal Inter-Village Cooperation Agency (BKAD); (2) the Magelang Regency Government; (3) the Central Java Provincial Government; (4) the Serayu-Opak River Basin Agency (BBWSSO); (5) mechanical sand mining companies (three private companies); and (6) non-mining local communities. Each of these actors holds different interests and institutional roles within the governance structure of sand mining management.

Government Institutions

Government institutions play a central role in regulating mining activities in the Mount Merapi area. Several levels of government are involved in the governance of sand mining. The Central Java Provincial Government, through the Energy and Mineral Resources Agency (ESDM), holds authority over mining permits and the issuance of Mining Business Licenses (IUP). Meanwhile, the Magelang Regency Government is responsible for environmental governance, particularly through the Environmental Agency (DLH), which oversees environmental impact considerations and community complaints related to mining activities. Because sand mining in the Merapi Area mainly occurs within river channels, mining permits also require technical recommendations from the Serayu-Opak River Basin Agency (BBWSSO), which is responsible for river basin management and infrastructure such as sabo dams. In addition, law enforcement related to mining violations formally falls under the authority of provincial and district Civil Service Police Units (Satpol PP) and Civil Servant Investigators (PPNS), with the Central Java Regional Police responsible for maintaining security and handling criminal violations. Although these institutions are expected to coordinate in regulating mining activities, field observations indicate that institutional coordination remains weak. Communities frequently perceive that government supervision focuses mainly on licensed mining operators, while enforcement against illegal mining activities remains limited.

Mining Companies and Mechanical Miners

Private mining companies represent another important actor in the conflict. In the Mount Merapi area of Magelang Regency, only a limited number of companies have obtained official mechanical mining permits. However, local residents report that numerous mining activities continue to occur outside these licensed operations. In some locations, mining activities are conducted without formal permits, particularly at community mining sites. This situation creates tensions not only between communities and mining companies but also among mining actors themselves. Licensed mechanical miners often claim that their operations comply with government regulations, while illegal miners sometimes report alleged violations by licensed operators to the media. These dynamics create the potential for horizontal conflict within the mining sector itself. At the same time, relations between mechanical miners and local communities remain highly contentious. Most residents in the affected villages strongly oppose large-scale mechanical mining because they perceive it as environmentally destructive and incompatible with the sustainability of local water resources.

Local Communities and BKAD Trimanunggal

Local communities living in the villages of Sewukan, Sengi, and Paten represent the primary actors opposing sand mining activities in the Tringsing River. These communities depend heavily on water resources originating from the river for domestic use and agricultural production. As a result, mining activities are widely perceived as a threat to environmental sustainability and local livelihoods. To strengthen collective resistance, the three villages formed the Trimanunggal Inter-Village Cooperation Agency (BKAD). This inter-village institution functions as a coordination platform for community mobilization and advocacy against mining activities in the Tringsing River. BKAD Trimanunggal has played a strategic role in organizing community resistance, facilitating communication among villages, and conveying community aspirations to government institutions. The organization has also attempted to pursue institutional channels to address the conflict, including submitting proposals to the Magelang Regency Government to remove the Tringsing River area from the official mining zone map. However, these efforts have not yet succeeded due to the complex bureaucratic procedures required to revise spatial planning regulations. Despite these challenges, cooperation among the three villages has strengthened local solidarity in defending the river ecosystem. Community leaders emphasize that preserving the Tringsing River is essential not only for environmental protection but also for maintaining long-term water security for agricultural communities on the slopes of Mount Merapi.

The interaction among these actors reflects a complex governance structure in which authority over mining management is fragmented across multiple institutions. While government agencies formally regulate mining permits and supervision, local communities often perceive these institutions as ineffective in controlling illegal mining activities and protecting environmental resources. At the same time, conflicts between

communities and mining companies are shaped by fundamentally different perceptions of the river. For mining actors, sand resources represent economic opportunities, often framed within narratives of river normalization and disaster mitigation. In contrast, local communities view the river primarily as a vital source of water and ecological sustainability. As a result, the sand mining conflict in the Tringsing River illustrates how competing interests between environmental protection, economic extraction, and institutional governance can produce prolonged conflicts in resource-dependent communities. To better understand the relationships among stakeholders involved in conflict, the actors and their interests are summarized in Table 1.

Actor	**Interest**	**Role**	**Conflict Position**
BKAD Trimanunggal	Protect river ecosystem	Community coordination	Strongly oppose mining
Mining companies	Economic extraction	Sand mining operations	Support mining
Provincial Government	Mining regulation	Licensing authority	Mixed
BBWSSO	River management	Technical recommendation	Neutral

Table 1. Key Actors and Stakeholder Positions of the Tringsing River Sand Mining Conflict

Table 1 summarizes the key stakeholders involved in the Tringsing River sand mining conflict, including their institutional roles, interests, and positions regarding mining activities. This analysis reveals a multi-actor conflict characterized by conflicting interests between local communities seeking to protect the environment and mining companies pursuing resource extraction, while various government agencies occupy regulatory and coordinating positions. To better understand these relationships and the structure of interactions between actors, Figure 2 visualizes a map of the conflict actors, depicting the patterns of competition and coordination that shape the dynamics of sand mining governance in the Tringsing River area.

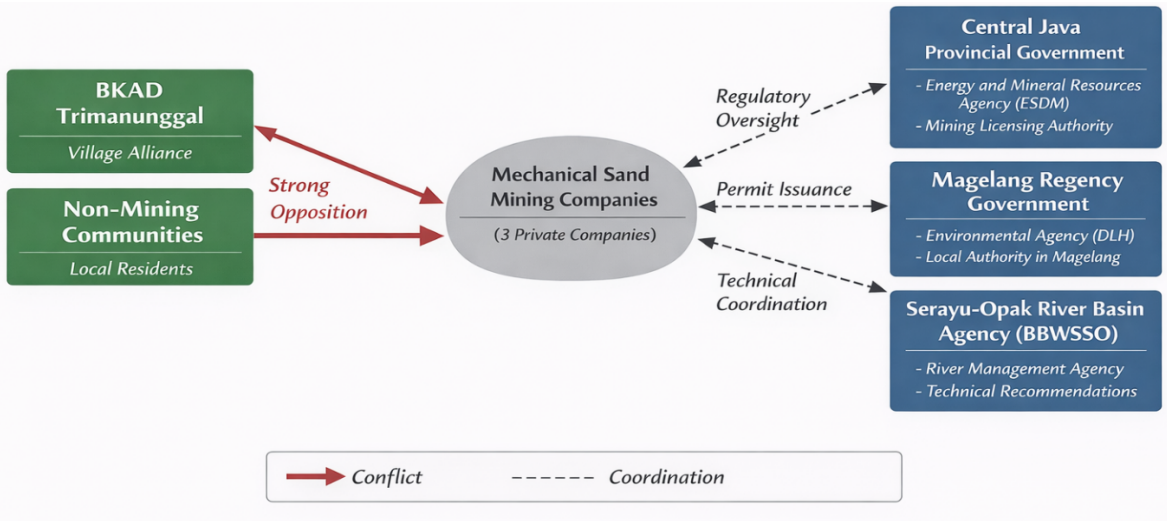

Figure 2. Conflict Actor Map. *Source:* Research analysis results

Discussion

Community Resistance in Environmental Conflicts

Sand mining conflicts in the Mount Merapi Area represent a complex environmental governance problem involving multiple actors with competing interests, including local communities, mining companies, and government institutions. The stakeholder analysis and actor mapping presented in this study reveal that the conflict is shaped not only by differing economic interests but also by institutional fragmentation and uneven power relations in natural resource governance. As illustrated in Figure 3, the conflict structure demonstrates a clear polarization between local communities seeking to protect environmental sustainability and mechanical mining companies pursuing sand extraction, while government institutions occupy regulatory and coordinating positions that are often perceived as inconsistent or fragmented.

The actor map further highlights the central role of local communities and the Trimanunggal Inter-Village Cooperation Agency (BKAD) in resisting mechanical sand mining in the Tringsing River area. Through this institutional platform, communities from the villages of Sewukan, Sengi, and Paten have coordinated collective actions, engaged in negotiations with government agencies, and advocated for the protection of river ecosystems. Their position reflects a form of grassroots environmental governance in which local actors mobilize collectively to safeguard ecological resources that are essential for community livelihoods.

Community resistance has also been expressed through various grassroots initiatives, including public campaigns rejecting mechanical mining and community monitoring of river conditions. These actions demonstrate that environmental governance in the Tringsing River area is not solely shaped by formal regulatory institutions but also by collective community efforts to protect shared ecological resources. In this sense, the emergence of BKAD Trimanunggal illustrates how locally embedded

institutions can function as effective mechanisms of community-based environmental governance in contexts where state regulation is perceived as insufficient.

Institutional Fragmentation in Sand Mining Governance

Despite the existence of formal regulatory frameworks governing mineral extraction and river management, sand mining governance in the Merapi Area remains characterized by institutional fragmentation. Multiple government institutions hold overlapping responsibilities related to mining permits, environmental monitoring, and river basin management. This institutional complexity often creates ambiguity regarding regulatory authority and enforcement.

The findings indicate that such fragmentation contributes significantly to the persistence of conflict. Communities frequently perceive government responses to mining issues as inconsistent, particularly when different agencies provide conflicting information regarding the legality of mining activities. For instance, statements from the Serayu-Opak River Basin Agency indicating that no technical recommendations had been issued for sand mining activities in the Tringsing River area created further uncertainty regarding the legitimacy of mining permits.This governance ambiguity weakens public trust in formal regulatory institutions and encourages communities to rely more heavily on local collective action to protect their environmental interests. As a result, environmental conflicts in the region are not merely the result of competing economic interests but are also shaped by weaknesses in institutional coordination and regulatory enforcement.

Attempts to resolve the conflict through dialogue and negotiation have also faced significant challenges. Meetings facilitated by village leaders and local institutions have attempted to bring together representatives from communities, government agencies, and other stakeholders. However, these initiatives have often encountered obstacles such as limited participation from key actors, unclear negotiation agendas, and differing interpretations of regulatory authority. These conditions illustrate the limitations of collaborative governance mechanisms when institutional roles remain fragmented and responsibilities are not clearly defined.

Environmental Conflict Implications for Sand Mining Governance

The dynamics observed in the Tringsing River conflict provide broader insights into environmental conflict and resource governance in extractive landscapes. One important development is the increasing role of environmental awareness in shaping local governance dynamics. Community leaders and local institutions in the Trimanunggal villages have actively promoted environmental education and conservation initiatives aimed at strengthening public understanding of the long-term impacts of unsustainable sand mining.

These initiatives have gradually fostered collective norms emphasizing environmental protection and sustainable resource management. Environmental concerns have also begun influencing local political processes. In several villages, candidates seeking election as village heads are increasingly expected to demonstrate a

commitment to protecting the Merapi slope environment. This phenomenon suggests that environmental governance is becoming embedded within local democratic practices, creating informal political incentives for local leaders to adopt environmentally responsible policies.

The conflict in the Tringsing River also reflects broader global concerns regarding sand extraction and its environmental consequences. Recent studies have highlighted sand mining as one of the fastest-growing environmental challenges associated with urbanization and infrastructure development worldwide. Excessive sand extraction has been linked to river degradation, biodiversity loss, and increased ecological vulnerability in many regions (Peduzzi, 2014; Torres et al., 2017). Similar to other cases documented in the global literature, the Tringsing River conflict illustrates how local communities often bear the environmental costs of resource extraction while economic benefits are captured by external actors.

Overall, this study contributes to the literature on environmental conflict and resource governance by demonstrating the strategic role of community-based institutions in shaping conflict dynamics in resource extraction contexts. While many studies emphasize interactions between state authorities and private extractive actors, the findings from the Tringsing River case highlight the importance of inter-village institutions in coordinating collective environmental resistance and protecting shared ecological resources. In volcanic landscapes such as the Merapi Area, where natural processes continuously reshape resource availability, locally embedded governance mechanisms can play a critical role in balancing ecological sustainability, community livelihoods, and resource management. These findings suggest that sustainable solutions to environmental conflicts require not only stronger institutional coordination but also greater recognition of community institutions as key actors in environmental governance.

Conclusion

Overall, these findings suggest that sand mining conflicts in the Merapi Area are not only driven by economic competition over natural resources, but are also shaped by community mobilization, fragmented governance arrangements, and evolving local environmental norms. The case of the Tringsing River shows that local communities, particularly through the Trimanunggal Inter-Village Cooperation Agency (BKAD), have played a central role in resisting mechanical sand mining and promoting environmental protection. These collective actions demonstrate how locally embedded institutions can strengthen community capacity to safeguard ecological resources in contexts where regulatory authority and institutional coordination remain fragmented.

Beyond its empirical contribution, this study highlights the importance of recognizing community-based institutions as key actors in environmental governance within extractive landscapes. The findings suggest that sustainable conflict resolution in sand mining areas requires stronger institutional coordination among government agencies while also acknowledging the role of local collective action in shaping governance

outcomes. In this regard, the Tringsing River case provides broader insights into how community mobilization can influence environmental conflict dynamics and contribute to more sustainable enviromental governance.

Based on the findings of this study, several recommendations can be proposed to improve sand mining governance in the Merapi Area. First, stronger coordination among government institutions is needed to address institutional fragmentation in licensing, supervision, and environmental regulation. Clearer regulatory mechanisms and more transparent communication between agencies can help reduce governance ambiguity that often triggers community distrust. Second, community-based institutions such as the BKAD Trimanunggal should be formally recognized and involved in environmental decision-making processes, particularly in monitoring and managing river resources. Strengthening community participation in governance arrangements can enhance environmental protection and conflict resolution. Future research may further explore the long-term effectiveness of community-based environmental governance in managing extractive resource conflicts in volcanic landscapes.

Acknowledgement

The author gratefully acknowledges the financial support provided by STPMD "APMD" Yogyakarta. The author also extends sincere appreciation to the local communities and village authorities in Sewukan, Sengi, and Paten for their cooperation and valuable insights during the fieldwork. Special thanks are also addressed to colleagues and research assistants who contributed to data collection and field surveys. The author further appreciates the constructive comments from anonymous reviewers and editors, which helped improve the quality of this article.

Author's declaration

Authors' contributions and responsibilities. Write the contribution of each author here, or mark the following column. Following the optional categories of authors' contributions below. The authors made substantial contributions to the conception and design of the study. The authors took responsibility for data analysis, interpretation and discussion of results. The authors read and approved the final manuscript.

Availability of data and materials

All data are available from the authors.

Competing interests

The authors declare no competing interest.

Additional information

Write additional information related to this research, if any.

References

Bebbington, A., Humphreys Bebbington, D., Sauls, L., Rogan, J., Agrawal, S., Gamboa, C., & Verdum, R. (2018). Resource extraction and infrastructure threaten forest cover and community rights. *Proceedings of the National Academy of Sciences*, *115*(52), 13164–13173. https://doi.org/10.1073/pnas.1812505115

Braun, V., & Clarke, V. (2021). *Thematic Analysis: A Practical Guide*. Sage Publications.

Bui, T. D. (2023). Natural resource governance and conflict resolution: Evidence from extractive sectors. *Energy Policy*, *176*, 113626. https://doi.org/10.1016/j.enpol.2023.113626

Charbonnier, S., Thouret, J.-C., & Lavigne, F. (2013). Rain-triggered lahars following the 2010 eruption of Merapi volcano. *Geomorphologie: Relief, Processus, Environnement*. https://journals.openedition.org/geomorphologie/10406

Creswell, J. W., & Creswell, J. D. (2020). *Research Design: Qualitative, Quantitative, and Mixed Methods Approaches* (5th ed.). SAGE Publications.

Creswell, J. W., & Poth, C. N. (2018). *Qualitative Inquiry and Research Design: Choosing Among Five Approaches*. Sage Publications.

Della Porta, D., & Diani, M. (2006). *Social Movements: An Introduction*. Blackwell Publishing.

Duker, A. E. C., Carr, G., & Bockstael, N. (2023). Global river sand mining and the need for governance reforms. *Resources Policy*, *82*, 103505. https://doi.org/10.1016/j.resourpol.2023.103505

Fisher, S., Abdi, D. I., & Ludin, J. (2001). *Working with Conflict: Skills and Strategies for Action*. Zed Books.

Flick, U. (2022). *An Introduction to Qualitative Research*. Sage Publications.

Galtung, J. (1996). *Peace by Peaceful Means: Peace and Conflict, Development and Civilization*. Sage Publications.

Geenen, S., & Verbrugge, B. (2021). Community mining and environmental justice struggles in the Global South. *The Extractive Industries and Society*, *8*(4), 101002. https://doi.org/10.1016/j.exis.2021.101002

Hajer, M., & Versteeg, W. (2019). Discursive governance and environmental politics. *Environmental Politics*, *28*(1), 1–19. https://doi.org/10.1080/09644016.2019.1546353

Harahap, N. (2020). *Penelitian Kualitatif* (H. Sazali, Ed.; 1st ed.). Wal ashri Publishing.

Koehnken, L., & Rintoul, M. (2018). *Impacts of Sand Mining on Ecosystem Structure, Process and Biodiversity: A Review*. WWF International.

Kondolf, G. M., Rubin, Z., & Minear, J. (2014). Dams on the Mekong: Cumulative sediment starvation. *Water Resources Research*, *50*(6). https://doi.org/10.1002/2013WR014651

Kuswijayanti, E. R., Dharmawan, A. H., & Kartodihardjo, H. (2007). Krisis socio-politico-ecology di kawasan konservasi. *Sodality*, *1*(1), 41–66. https://doi.org/10.22500/sodality.v1i1.5930

Leal Filho, W., & Azul, A. (2021). The unsustainable use of sand: Reporting on a global problem. *Sustainability*, *13*(6), 3356. https://doi.org/10.3390/su13063356

Lincoln, Y., & Guba, E. (1985). *Naturalistic Inquiry*. Sage Publications.

Marschke, M., & Rousseau, J.-F. (2022). Sand ecologies, livelihoods and governance in Southeast Asia. *Resources Policy*, *77*, 102671. https://doi.org/10.1016/j.resourpol.2022.102671

Martinez-Alier, J., Temper, L., Del Bene, D., & Scheidel, A. (2016). Is there a global environmental justice movement. *The Journal of Peasant Studies*, *43*(3), 731–755. https://doi.org/10.1080/03066150.2016.1141198

Miles, M., Huberman, M., & Saldaña, J. (2019). *Qualitative Data Analysis: A Methods Sourcebook*. Sage Publications.

Morgan, D. (2019). *Basic and Advanced Focus Groups*. Sage Publications.

Otani, K., & Suharyanto. (2013). Debris Flow Disaster Mitigation through Community-Based Integrated Sediment Management in the Mt. Merapi Area. *Journal of the Civil Engineering Forum*, *22*(1).

Peduzzi, P. (2014). Sand, rarer than one thinks. *Environmental Development*, *11*, 208–218. https://doi.org/10.1016/j.envdev.2014.04.001

Peluso, N. L., & Watts, M. (2001). *Violent Environments*. Cornell University Press.

Prayoga, R., Suryani, E., & Kurniawan, A. (2024). Land-use regulation and local governance conflicts in disaster-prone regions. *Land Use Policy*, *137*, 106982. https://doi.org/10.1016/j.landusepol.2023.106982

Rizki, D. A., & Putranto, A. K. D. (2018). Evaluasi Penyelesaian Konflik Penambangan Pasir di Daerah Aliran Sungai (DAS) Progo di Desa Poncosari, Kecamatan Srandakan, Kabupaten Bantul. *Paradigma: Jurnal Ilmu Administrasi*, *7*(2), 165–181.

Scheidel, A., Del Bene, D., & Liu, J. (2020). Environmental conflicts and defenders: A global overview. *Global Environmental Change*, *63*, 102104. https://doi.org/10.1016/j.gloenvcha.2020.102104

Sugiyono. (2021). *Metode Penelitian Kualitatif: Untuk Penelitian yang Bersifat Eksploratif, Enterpretif, Interaktif dan Konstruktif*. Alfabeta.

Sulaksono, N., & Hadiyan, Y. (2015). Conflict Resolution Strategy for Ecosystem Problems of Mount Merapi National Park: Some Lesson from Jurang Jero. *Prosiding Seminar Nasional Masyarakat Biodiversitas Indonesia*, *1*(6), 1370–1374.

Surono, Jousset, P., Pallister, J., Boichu, M., Buongiorno, M. F., Budisantoso, A., Costa, F., Andreastuti, S., Prata, F., Schneider, D., Clarisse, L., Humaida, H., Sumarti, S., Bignami, C., Griswold, J., Carn, S., Oppenheimer, C., & Lavigne, F. (2012). The 2010 explosive eruption of Java's Merapi volcano-A "100-year" event. *Journal of Volcanology and Geothermal Research*, *241–242*(May 2018), 121–135. https://doi.org/10.1016/j.jvolgeores.2012.06.018

Torres, A., Brandt, J., Lear, K., & Liu, J. (2017). A looming tragedy of the sand commons. *Science*, *357*(6355), 970–971. https://doi.org/10.1126/science.aao0503

Tran, D., & Hanaček, K. (2023). Environmental defenders and social movements in environmental conflicts. *Nature Sustainability*, *6*, 1045–1053. https://doi.org/10.1038/s41893-023-01126-4

Varhan, V., & Taufiq, A. (2019). Analisis gerakan serikat buruh Slenggrong Merapi Punokawan dalam upaya resolusi konflik tambang pasir. *Journal of Politic and Government Studies*, *8*(4), 401–410. https://ejournal3.undip.ac.id/index.php/jpgs/article/view/25069

Widati, W., Sakina, A. W., & Adiwirahayu, A. (2021). The Integration of Sister Village Functions in Mount Merapi Disaster Management during the COVID-19 Pandemic. *Jurnal Pemberdayaan Masyarakat: Media Pemikiran Dan Dakwah Pembangunan*, *5*(2), 381–410. https://doi.org/10.14421/jpm.2021.052-05

Widianto, H. W. (2019). Konflik Tambang Pasir Besi Lumajang: Analisis Akar dan Resolusi. *Mozaik: Kajian Ilmu Sejarah*, *11*(1), 99–111.

Yasmin, T., & Clark, J. (2024). Towards sustainable governance of freshwater sand. *Earth System Governance*, *22*, 100228. https://doi.org/10.1016/j.esg.2024.100228

Yin, R. (2018). *Case Study Research and Applications*. Sage Publications.

Yudhistira, Y., Hidayat, W. K., & Hadiyarto, A. (2011). Kajian dampak kerusakan lingkungan akibat kegiatan penambangan pasir di Desa Keningar daerah kawasan Gunung Merapi. *Jurnal Ilmu Lingkungan*, *9*(2), 76–84. https://doi.org/10.14710/jil.9.2.76-84

Zografos, C., Robbins, P., & Molle, F. (2020). Environmental justice and resource governance. *Global Environmental Change*, *65*, 102185. https://doi.org/10.1016/j.gloenvcha.2020.102185