

Examining the Social and Environmental Risks of Small-Scale Mining in Barangay Pawa, Boac, Marinduque

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ABSTRACT

Small-scale mining, often regarded as a vital source of livelihood for rural communities, can also impose significant environmental, health, and social risks. This study investigates the multifaceted impacts of small-scale mining in Barangay Pawa, Boac, Marinduque, focusing on stakeholder perceptions regarding mining operations, environmental degradation, health and safety, regulatory compliance, and economic contributions. Data was collected through surveys and interviews from 285 respondents, including miners, residents, local officials, and business owners, to explore the relationships between mining activities and associated social risks. The study finds that small-scale mining in Barangay Pawa results in severe environmental damage, including water contamination and deforestation, with considerable health risks such as respiratory diseases and skin conditions among miners and nearby residents. Additionally, the study highlights the disruption of local livelihoods, the displacement of families, and heightened community conflicts, all exacerbated by weak regulatory enforcement. The findings suggest that while small-scale mining provides short-term economic benefits, it often leads to economic instability and dependence on an unsustainable industry. Recommendations include strengthening regulatory frameworks, enforcing health and safety standards, and promoting economic diversification through sustainable livelihoods. The study emphasizes the need for a comprehensive approach to mitigate mining's adverse effects while fostering long-term community resilience and sustainable development.

Keywords: *Economic Diversification, Environmental Degradation, Health and Safety, Livelihood Disruption, Regulatory Compliance, Social Conflicts*

INTRODUCTION

In the heart of rural communities around the world, small-scale mining is often viewed as a lifeline—a way to generate income, support families, and fuel local economies. Yet beneath this seemingly innocent facade lies a complex web of environmental degradation, social upheaval, and health risks that threaten to undermine the very communities they aim to sustain. Barangay Pawa in Boac, Marinduque, is no exception to this paradox. While small-scale mining here offers immediate economic benefits, its consequences on local ecosystems, public health, and social stability raise critical concerns that demand urgent attention. This study explores the multifaceted impact of small-scale mining activities in Barangay Pawa, focusing on the perceptions of local stakeholders regarding its operations, environmental effects, health and safety standards, regulatory compliance, and economic contributions.

As the Philippines advances toward a more digital public service environment, understanding the global debate surrounding small-scale mining often revolves around its dual nature: a source of livelihood that contributes to poverty alleviation, but also a driver of unsustainable environmental and social consequences. Mathews et al. (2021) argue that poorly managed mining operations are often marked by inefficiencies, lack of technical knowledge, and inadequate community engagement, all of which contribute to long-term environmental and social damage. These findings resonate with the

situation in Barangay Pawa, where mining operations are seen to be poorly managed, and often out of sync with the needs and expectations of local communities. Thus, this study investigates how local stakeholders assess mining practices, with particular emphasis on identifying opportunities for improvement and strategies to reduce harm.

Environmental impact is perhaps the most profound risk associated with small-scale mining. Dávila et al. (2022) and Hernández et al. (2021) emphasize the significant ecological damage caused by mining, including deforestation, water contamination, and soil erosion. In Barangay Pawa, the environmental footprint of mining is a constant concern, with water contamination being the most alarming issue identified by local stakeholders. Garcia et al. (2020) highlighted that water pollution from mining activities can lead to severe health risks and ecosystem disruption, with ramifications that extend well beyond the mining sites. These concerns are not just theoretical but are felt daily by the residents, as access to clean water becomes increasingly limited, further exacerbating the already fragile conditions of rural life.

In terms of health and safety, small-scale mining remains a risky occupation. Jara et al. (2020) note that workers in mining operations are often exposed to hazardous materials and poor working conditions, leading to an array of health issues, including respiratory diseases and skin conditions. This study confirms these findings, with stakeholders in Barangay Pawa expressing concern over inadequate safety protocols and lack of access to medical care. The inconsistency in providing personal protective equipment (PPE) and the absence of comprehensive health monitoring systems are seen as major contributors to the health crisis among miners and nearby residents. López et al. (2021) suggest that stronger enforcement of health and safety regulations, along with a well-structured health monitoring system, could help mitigate these risks, ensuring that workers and their communities are better protected from mining-related hazards.

Regulatory compliance is another critical issue identified by the stakeholders in Barangay Pawa. While some regulations are in place, González et al. (2021) argue that weak enforcement and inconsistent monitoring lead to unsustainable practices that undermine both the environment and workers' rights. The findings from this study show that mining operators in Barangay Pawa often circumvent regulations, contributing to environmental destruction and poor labor conditions. The lack of penalties for non-compliance and the irregularity of inspections are seen as major obstacles in curbing the negative effects of mining. López et al. (2021) further emphasize the importance of strengthening regulatory frameworks and ensuring that penalties for violations are rigorously enforced. This would ensure that mining activities are conducted within legal boundaries and that their adverse impacts on the community and environment are minimized.

Economically, small-scale mining is often hailed as a critical source of income in rural areas. However, the economic benefits of mining are frequently short-lived and volatile. Pérez and Martínez (2023) note that while small-scale mining provides immediate financial relief to local families, it often does not contribute to long-term economic stability. In Barangay Pawa, respondents expressed concerns over the economic instability linked to mining, citing fluctuating income levels and dependency on an industry that is susceptible to market changes and resource depletion. Torres et al. (2022) recommend the promotion of economic diversification, particularly through sectors like agriculture, small businesses, and eco-tourism, to mitigate the economic risks associated with mining and reduce dependency on a single, unstable industry.

The broader social risks linked to small-scale mining are no less significant. Ibrahim et al. (2021) and Veltz et al. (2020) argue that mining disrupts traditional livelihoods, especially in agriculture and fishing, which are the mainstays of rural economies. In Barangay Pawa, the negative impact of mining on farming and fishing is evident, with local stakeholders reporting a reduction in available land and

water resources. This disruption is exacerbated by conflicts over resource allocation, land disputes, and the forced displacement of families, as documented by Martínez et al. (2022). These findings highlight the need for better resource management and conflict resolution mechanisms to address the growing tensions between miners and non-miners and to mitigate the risks of displacement.

Mining's impact on food and water security is particularly troubling, as many communities in mining-affected areas rely heavily on local agriculture and fisheries for sustenance. Liu et al. (2022) point out that mining-induced water pollution and soil degradation disrupt local food systems, leading to food insecurity. The contamination of water sources, a major concern in Barangay Pawa, not only affects drinking water but also harms agricultural productivity and aquatic biodiversity. Zhang et al. (2021) stress the importance of addressing these issues through comprehensive environmental restoration efforts and sustainable farming practices. In light of these findings, improving water quality and soil health should be prioritized to ensure the long-term viability of local food systems and enhance community resilience.

Social conflicts, especially over land ownership and resource distribution, are another persistent problem in mining areas. Büscher et al. (2020) argue that mining exacerbates tensions by intensifying competition for land and resources, often leading to violent conflicts. In Barangay Pawa, land disputes and disagreements between miners and local residents have created an atmosphere of social unrest. As Veltz et al. (2020) suggest, these conflicts can have far-reaching consequences, not only disrupting community harmony but also hindering efforts to implement sustainable mining practices. Therefore, establishing transparent and fair land tenure systems and fostering dialogue between stakeholders are critical to reducing social conflicts and promoting cooperative management of mining resources.

The findings from this study are in line with the broader literature on small-scale mining and its complex impacts on rural communities. The negative effects of mining on the environment, health, and social stability are well-documented, yet efforts to address these issues remain insufficient in many regions. Büscher et al. (2020) advocate for a more integrated approach to mining regulation, one that involves local communities, government agencies, and mining operators in decision-making processes. By taking a multi-stakeholder approach, it is possible to develop strategies that not only mitigate the adverse effects of mining but also promote sustainable practices that benefit both the local economy and the environment.

Small-scale mining in Barangay Pawa has undeniable economic importance, yet its environmental and social costs cannot be ignored. This study aims to contribute to a deeper understanding of the risks associated with mining and provide recommendations for policies that can mitigate these impacts. By focusing on the perspectives of local stakeholders, this research hopes to offer actionable insights for policymakers, mining operators, and community leaders, fostering more sustainable and socially responsible mining practices that benefit everyone in Barangay Pawa and beyond.

LITERATURE REVIEW

Small-scale mining (SSM) has long been a critical economic activity in many rural areas, particularly in developing countries like the Philippines. However, despite its economic contributions, the practice has raised significant concerns regarding environmental degradation, public health risks, and social instability. Recent literature from 2021 to 2023 offers a nuanced perspective on the various impacts of small-scale mining, with an emphasis on the need for more effective regulations and sustainable practices.

Mathews et al. (2021) emphasized the operational challenges faced by small-scale mining, particularly the lack of technical expertise, poor resource management, and limited community engagement. These

inefficiencies often lead to poor management practices that exacerbate the negative social and environmental consequences of mining. The findings align with Dávila et al. (2022), who explored the environmental impacts of small-scale mining, particularly focusing on deforestation and water contamination. Their research found that unregulated mining activities often result in severe water pollution, posing significant risks to both local ecosystems and human health. Similarly, Hernández et al. (2021) highlighted the broader ecological consequences of mining, such as habitat destruction and soil erosion, which further disrupt local agriculture and fishing—two key livelihoods in mining areas.

In terms of public health, Garcia et al. (2020) revealed the severe consequences of water contamination caused by mining operations. The toxic waste released into water sources has been linked to a variety of diseases, including waterborne illnesses that disproportionately affect vulnerable communities. This concern is echoed by Jara et al. (2020), who discussed the health and safety risks faced by miners, particularly the lack of proper protective equipment. Their study found that the absence of adequate safety measures leads to respiratory diseases, skin conditions, and injuries, calling for improved health monitoring and safety protocols. Oliveira and Santos (2021) further stressed the need for effective occupational health standards to mitigate long-term health risks, particularly in remote mining areas where healthcare resources are limited.

Regulatory compliance in small-scale mining remains a persistent challenge. González et al. (2021) pointed out the weak enforcement of mining laws, which allows for unsustainable practices and environmental degradation. The lack of effective monitoring and penalties for violations exacerbates the situation, leading to further exploitation of resources without consideration for long-term consequences. Pérez and Martínez (2023) also observed that although small-scale mining generates income and employment in local communities, these benefits are often short-lived and associated with economic volatility. They suggested that diversification of the local economy is essential for reducing dependence on mining and promoting sustainable development.

The social risks associated with small-scale mining are also a key concern in the literature. Büscher et al. (2020) examined the social tensions arising from mining activities, particularly land disputes and conflicts over resource control. These conflicts often lead to violence, displacement, and social instability, undermining community cohesion. Ibrahim et al. (2021) found that small-scale mining activities disrupt traditional livelihoods, such as farming and fishing, by contributing to land degradation and water pollution. Rodríguez et al. (2022) highlighted the economic vulnerability of mining communities, particularly in relation to the loss of agricultural productivity and increased poverty. This disruption underscores the need for alternative livelihoods, including sustainable industries like eco-tourism and agriculture, to mitigate the negative effects of mining on local economies.

The issue of displacement and resettlement is another area of concern. Hernández et al. (2021) argued that mining-induced displacement often results in inadequate resettlement programs, leaving displaced families without proper compensation or support. The loss of social and cultural ties during resettlement further exacerbates the negative impacts on displaced communities. Tan et al. (2021) noted that without proper planning and community engagement, resettlement programs often fail to improve the living conditions of those affected by mining activities.

Food and water security are also deeply impacted by small-scale mining. Liu et al. (2022) found that mining activities often lead to soil erosion and water contamination, which disrupt local agricultural production and access to safe drinking water. Zhang et al. (2021) emphasized the need for land restoration and sustainable farming practices to mitigate these environmental risks. The contamination of water sources, in particular, poses significant risks to food security, as local communities depend on clean water for both drinking and agricultural purposes.

Finally, social conflicts arising from mining activities are a major concern in mining-affected areas. Veltz et al. (2020) observed that mining intensifies competition for resources, leading to conflicts between miners and non-miners. Martínez et al. (2022) highlighted that disputes over land ownership and resource allocation often lead to violence and social unrest. Addressing these issues requires transparent land tenure systems and conflict resolution mechanisms to promote social harmony and prevent violent confrontations.

MATERIALS & METHODS

This study employed a descriptive-correlational research design integrated with regression analysis to explore the social risks associated with small-scale mining in Barangay Pawa, Boac, Marinduque. The descriptive component of the design provided a comprehensive overview of the socio-economic and environmental conditions in the community, focusing on key areas such as mining operations, health and safety practices, environmental impacts, regulatory compliance, and the economic contributions of small-scale mining. This aspect of the study aimed to gather a snapshot of the community's current situation, emphasizing the various social risks posed by mining activities, including health hazards, livelihood disruption, displacement, food and water security issues, and the emergence of community conflicts. In addition, the correlational aspect of the study examined the relationships between mining activities and these identified social risks. Specifically, it sought to determine how exposure to toxic chemicals, unsafe working conditions, and land degradation contributed to adverse social outcomes, such as respiratory diseases, economic instability, and social displacement. By using regression analysis, the study aimed to determine predictive relationships between mining variables and social consequences, thus offering insights into how regulatory measures could help mitigate these risks and enhance community resilience.

The study was conducted in Barangay Pawa, a rural community where small-scale mining, especially gold extraction, plays a significant role in local livelihoods. The community has faced significant environmental degradation, including water contamination and deforestation, as a result of unregulated mining activities. Recent research has shown that small-scale mining is often linked to environmental challenges, such as habitat destruction and pollution, which not only affect biodiversity but also disrupt local food production systems (Dávila et al., 2022; Hernández et al., 2021). This study primarily focused on understanding the broader implications of these mining activities on community health, food and water security, livelihood stability, and the occurrence of social conflicts. Furthermore, the research explored how local governance structures and regulatory frameworks influenced the management of mining operations and the mitigation of their social and environmental consequences. According to González et al. (2021), inadequate regulatory enforcement can lead to poor mining practices, which exacerbate the negative impacts on both the environment and public health. Interviews with key stakeholders—including local government officials, health officers, miners, and residents—were incorporated into the study to complement the survey data and provide a more nuanced understanding of the challenges the community faces, as well as the local perceptions of mining's impact.

To ensure a representative and balanced sample, a stratified random sampling method was employed, which surveyed 285 respondents from different sectors of the community. These included small-scale miners, local residents, government officials, health officers, civil society representatives, and business owners. This approach was designed to capture a range of perspectives on the social risks associated with small-scale mining. The use of a structured questionnaire with Likert-scale items allowed for the collection of quantitative data on the community's perceptions of mining's impact. The questionnaire was complemented by qualitative interviews, which provided valuable contextual insights into how individuals and groups within the community experienced the social and environmental risks of

mining. A similar mixed-method approach has been used in other studies, such as those by López et al. (2021), to understand the social dimensions of small-scale mining and its effects on local communities.

In addition to the surveys and interviews, various statistical methods were employed to analyze the data. Descriptive statistics were used to summarize the overall perceptions of the respondents regarding the social risks associated with mining, while t-tests and ANOVA were applied to examine potential differences in perceptions between various groups, such as miners versus non-miners. Pearson correlation was used to explore the relationships between mining activities and social risks, providing a clearer picture of how specific factors—such as unsafe mining practices and exposure to toxic substances—are associated with adverse health and social outcomes. Regression analysis, a powerful tool for predicting relationships between variables, was used to examine how mining operations might contribute to long-term negative consequences for the community. This statistical approach aligns with similar studies, such as those conducted by Tan et al. (2021), which applied regression analysis to assess the impacts of mining on public health and economic stability. By using a mixed-method approach, the study was able to triangulate data from multiple sources, ensuring a comprehensive and well-rounded assessment of the social risks posed by small-scale mining in Barangay Pawa.

The significance of this study lies in its ability to provide an in-depth examination of how small-scale mining affects the social fabric of a rural community in the Philippines. The findings can contribute to ongoing discussions about the need for better regulatory frameworks, improved community engagement, and the implementation of sustainable mining practices. By highlighting the interconnectedness of environmental degradation, health risks, livelihood disruptions, and social conflicts, this research adds to the growing body of literature emphasizing the need for a more holistic approach to small-scale mining regulation. According to Costa et al. (2022), the failure to address the complex web of risks associated with small-scale mining often leads to long-term economic and social instability. As small-scale mining remains a significant livelihood activity for many rural communities, it is critical that governments, miners, and civil society organizations collaborate to develop more sustainable mining practices that can mitigate these risks and support the well-being of local communities.

Moreover, this study underscores the importance of data-driven policy recommendations in addressing the negative impacts of small-scale mining. By utilizing statistical methods to quantify the relationships between mining activities and social risks, the study provides a solid foundation for evidence-based recommendations aimed at reducing these risks. Effective interventions may include the enforcement of stronger environmental regulations, the establishment of health and safety standards for miners, and the promotion of alternative livelihoods to reduce dependence on mining (Pimentel et al., 2020). Additionally, as López and Vargas (2021) have argued, ensuring the active participation of local communities in decision-making processes is critical to achieving long-term, sustainable solutions to the challenges posed by small-scale mining.

RESULTS AND DISCUSSION

1. How do local stakeholders assess the impact of small-scale mining activities in terms of:

- 1.1 Mining Operations;**
- 1.2 Environmental Impact;**
- 1.3 Health and Safety Practices;**
- 1.4 Regulatory Compliance; and**
- 1.5 Economic Contribution?**

Table 1
Overall Assessment of Small-Scale Mining Activities

Category	Overall Mean	Standard Deviation	Interpretation
Mining Operations	2.43	0.96	Moderate Negative Impact
Environmental Impact	3.02	1.03	High Negative Impact
Health and Safety Practices	2.52	1.04	High Negative Impact
Regulatory Compliance	2.48	1.03	Moderate Negative Impact
Economic Contribution	2.91	0.95	High Negative Impact

Table 1 presents the overall assessment of small-scale mining activities in Barangay Pawa, Boac, Marinduque, reveals significant concerns across all five key areas—Mining Operations, Environmental Impact, Health and Safety Practices, Regulatory Compliance, and Economic Contribution. These findings highlight the adverse effects that small-scale mining has on local communities and emphasize the urgent need for interventions to mitigate these issues.

Mining Operations were assessed with an overall mean score of 2.43, indicating a moderate negative impact. Respondents generally disagreed with the assertion that small-scale mining activities are well-managed in Barangay Pawa. Issues identified include inefficient excavation methods, poor communication between miners and the community, and a lack of adequate measures to prevent land degradation. These findings align with recent studies that suggest small-scale mining operations are often characterized by a lack of technical expertise, poor resource management, and insufficient community engagement (Mathews et al., 2021). The poor management of mining operations is linked to long-term environmental and social consequences, which can escalate if not addressed through better planning and resource management.

The Environmental Impact of small-scale mining was assessed with a mean score of 3.02, reflecting a high negative impact. Stakeholders expressed strong concerns regarding the degradation of the local environment, including deforestation, water contamination, soil erosion, and the disruption of wildlife habitats. The highest concern was water contamination (mean score = 3.09), underscoring the critical issue of water pollution in mining-affected areas. This result is consistent with findings from Garcia et al. (2020), who highlighted that mining-induced water pollution poses significant risks to both human health and local ecosystems. Furthermore, the high negative environmental impact associated with small-scale mining is well-documented in literature, with researchers pointing to the long-term ecological damage caused by unregulated mining practices (Dávila et al., 2022; Hernández et al., 2021). Immediate action is needed to enforce water management strategies, reforestation programs, and stricter environmental regulations to minimize further harm to the local ecosystem.

In terms of Health and Safety Practices, the overall mean score of 2.52 suggests a high negative impact, with stakeholders indicating concerns about inadequate health and safety measures for miners. Issues such as a lack of proper protective equipment, insufficient medical assistance, and the absence of emergency response teams were highlighted as major risks to miners' health. These findings echo the work of Jara et al. (2020), who stressed that inadequate safety measures in small-scale mining expose workers to serious health risks, including respiratory diseases, skin conditions, and injuries. Despite some availability of basic safety gear, the inconsistent provision of adequate protection for all workers exacerbates these health risks, as noted by López et al. (2021). Furthermore, the lack of health services in mining areas often leads to untreated health conditions, affecting both miners and surrounding communities. Comprehensive health and safety interventions are crucial to protecting miners and mitigating these health hazards.

Regarding Regulatory Compliance, the overall mean score of 2.48 reveals that small-scale mining operations in Barangay Pawa face significant regulatory shortcomings, particularly in the areas of environmental regulation and labor law compliance. While some degree of licensing and inspection exists, the enforcement of these regulations remains weak. Respondents highlighted concerns about the lack of penalties for violators and the inconsistent monitoring of mining activities. These issues reflect findings from González et al. (2021), who argued that weak regulatory enforcement leads to unsustainable mining practices, harming both the environment and workers' rights. Similarly, the work of López et al. (2021) emphasizes the need for regular inspections and stronger penalties for non-compliance to ensure that mining activities follow legal and environmental guidelines. Strengthening regulatory frameworks and improving enforcement mechanisms are essential steps toward reducing the negative impacts of small-scale mining.

The Economic Contribution of small-scale mining in Barangay Pawa was assessed with an overall mean score of 2.91, indicating a high negative impact. While mining provides some economic benefits, such as job creation and income generation for local families, these benefits are perceived as short-term and unstable. Respondents expressed concerns about the long-term sustainability of mining, citing its contribution to economic volatility and dependency on the mining sector. This aligns with studies by Pérez and Martínez (2023), who argued that small-scale mining, while offering immediate economic relief, often fails to provide sustainable economic growth. The fluctuating nature of mining income makes communities vulnerable to economic instability, underscoring the need for diversification of the local economy. Policymakers must promote alternative livelihoods, such as agriculture, eco-tourism, and small businesses, to reduce dependency on mining and foster long-term economic stability (Torres et al., 2022).

These findings have significant implications for policymakers, local government units (LGUs), mining operators, and affected communities. There is a clear need for stronger enforcement of environmental, health, and safety regulations to mitigate the adverse effects of mining. Additionally, the promotion of sustainable and responsible mining practices is essential to reduce environmental degradation and protect the health of miners and surrounding communities. The local government and policymakers should prioritize diversifying the local economy to reduce the community's dependence on mining, thereby fostering long-term economic resilience. Furthermore, improving communication between miners, the community, and local authorities is crucial for effective governance and sustainable development.

In conclusion, while small-scale mining provides economic opportunities, its negative impacts on health, the environment, and social stability cannot be overlooked. Stakeholders in Barangay Pawa recognize the need for better management, improved safety standards, and stricter regulatory enforcement. Addressing these challenges requires a multi-faceted approach involving the active participation of local communities, mining operators, government agencies, and advocacy groups. By implementing comprehensive strategies to mitigate the negative impacts of small-scale mining, it is possible to foster a more sustainable and equitable future for mining-affected communities.

2. How do local stakeholders assess the impact of small-scale mining activities on social risks in terms of:

- 2.1 Health risks;**
- 2.2 Livelihood disruption;**
- 2.3 Displacement and resettlement;**
- 2.4 Food and water security; and**
- 2.5 Community conflicts?**

Table 2
Overall Scores of Local Stakeholders' Assessment of Small-Scale Mining Activities

Category	Overall Mean Score	Standard Deviation	Interpretation
Health Risks	3.00	1.39	Severe Impact
Livelihood Disruption	3.02	1.01	Severe Impact
Displacement and Resettlement	2.61	1.08	Severe Impact
Food and Water Security	2.99	0.99	Severe Impact
Community Conflicts	2.87	1.26	Severe Impact

Table 2 shows the overall findings from the local stakeholders' assessment of small-scale mining activities in Barangay Pawa highlight that mining operations have a severe impact across several key areas, including health risks, livelihood disruption, displacement and resettlement, food and water security, and community conflicts. This section discusses each of these areas based on the findings, the implications of these results, and related literature and studies from 2022 to the present.

The mean score of 3.00 (SD = 1.39) indicates a strong consensus among stakeholders that mining activities have severe health consequences, particularly with respect to respiratory diseases and skin conditions. Mining operations are known to expose workers and surrounding communities to harmful substances like dust, chemicals, and toxic mining waste, which can lead to long-term health issues. The highest concern identified was related to skin diseases (mean = 3.06), highlighting the exposure to mining-related chemicals, while respiratory diseases (mean = 2.94) were also a significant concern, though slightly less so. This aligns with the findings of Costa et al. (2022), who pointed out that exposure to toxic substances in mining environments frequently leads to diseases like respiratory illnesses, dermatitis, and other skin disorders. These findings underscore the need for stricter enforcement of health and safety regulations and improved protective measures for miners and affected communities. In addition, Smith and Harris (2021) noted that proper health surveillance programs are critical to identifying and mitigating these health risks in mining regions.

With a mean score of 3.02 (SD = 1.01), local stakeholders strongly agreed that small-scale mining has disrupted local livelihoods, particularly in agriculture and fishing. The results reveal that mining operations have led to a reduction in opportunities for traditional livelihood activities such as farming and fishing, which have historically been vital sources of income for the community. Rodríguez et al. (2022) emphasized that small-scale mining often results in land degradation, water contamination, and a decline in agricultural productivity, all of which exacerbate food insecurity and economic instability. This disruption is evident in the high scores for the negative effects of mining on agriculture and fishing (mean = 3.13). Local economies are highly dependent on these sectors, and their decline leads to long-term social and economic vulnerabilities. The need for alternative livelihoods, including support for diversification into sustainable industries such as eco-tourism, is critical. According to López and Vargas (2021), promoting diversification is essential to ensuring the resilience of mining-affected communities.

The 2.61 mean score (SD = 1.08) for displacement and resettlement issues indicates that mining has caused severe displacement, but stakeholders disagreed on the adequacy of resettlement assistance. The highest mean score of 2.76 concerning the displacement of families illustrates that mining activities have forced many individuals and families to relocate. However, the lowest mean score of 2.50 related to the improvement of living conditions after resettlement suggests dissatisfaction with the relocation process. Hernández et al. (2021) have argued that the resettlement programs associated with mining are often inadequate, leading to further socioeconomic instability for displaced families. The disruption of social and cultural ties (mean = 2.58) further exacerbates the situation, as families

lose not only their homes but also their community networks, which are essential for mutual support and resilience. Strengthening resettlement programs to ensure that displaced families receive adequate compensation and support is critical for reducing the negative social impacts of mining.

Local stakeholders reported a severe impact on food and water security, with a mean score of 2.99 (SD = 0.99). Mining activities have contributed to the contamination of water sources (mean = 3.00) and the deterioration of soil quality (mean = 3.03), both of which significantly affect food production and access to safe drinking water. The findings highlight concerns about the long-term sustainability of local agriculture and fishery industries. As Liu et al. (2022) pointed out, mining often leads to soil erosion and water contamination, which disrupts local food systems and exacerbates food insecurity. The community's reliance on natural resources for sustenance makes it especially vulnerable to these environmental risks. The results emphasize the need for better water management practices, pollution control measures, and land reclamation strategies to restore the affected ecosystems. Zhang et al. (2021) also stress that improving soil quality and investing in sustainable farming practices are key to mitigating these impacts.

Finally, the assessment of community conflicts related to small-scale mining indicated a severe impact, with a mean score of 2.87 (SD = 1.26). Stakeholders reported that land disputes (mean = 3.08) and conflicts over natural resources (mean = 2.87) are among the most significant issues arising from mining activities. The tensions between miners and non-miners (mean = 2.68) reflect the social unrest within the community, driven by competing interests and unequal benefits from mining activities. According to Miller et al. (2021), mining often intensifies competition for land and resources, leading to conflicts that undermine social cohesion. Addressing these conflicts requires transparent land tenure systems and legal frameworks for resource sharing. Martínez et al. (2022) suggest that promoting dialogue between all stakeholders, including miners, local residents, and government authorities, is essential for resolving disputes and fostering sustainable mining practices.

The results from this study underscore the complex and multifaceted impact of small-scale mining on local communities, particularly in terms of health risks, livelihoods, displacement, food and water security, and community conflicts. The severe negative effects observed in all categories highlight the urgent need for more effective policies and practices to mitigate these risks. The findings also suggest that the current regulatory framework may be insufficient in addressing these challenges, which calls for stronger enforcement of environmental, health, and safety standards, as well as better support for alternative livelihoods and resettlement programs.

In conclusion, small-scale mining activities in Barangay Pawa have significant social and environmental impacts, which local stakeholders perceive as severe across key areas. These findings align with the broader body of literature on the negative consequences of unregulated mining, particularly in rural communities. Moving forward, it is essential for policymakers, mining operators, and local communities to collaborate on developing and implementing strategies that can reduce the adverse effects of mining while promoting sustainable development and social stability.

3. How do mining activities contribute to social risks in affected communities?

Mining activities in affected communities contribute to various social risks, particularly through environmental degradation, health hazards, and economic instability. The contamination of local water sources and soil, often due to mining waste, exposes communities to significant health risks, such as respiratory diseases, skin conditions, and waterborne illnesses. In a study by Büscher et al. (2020), it was noted that mining activities are a significant source of environmental pollution, leading to widespread contamination of water and air, which negatively affects the health of both miners and the surrounding population. These health issues create significant burdens on local healthcare systems,

which are often ill-equipped to handle the increased demand for medical care caused by mining-related illnesses.

In addition to health risks, mining also disrupts traditional livelihoods, especially agriculture and fishing, which are vital for many rural communities. As mining operations expand, they often cause land degradation and water pollution, both of which severely affect agricultural productivity and fishing yields. A study by Ibrahim et al. (2021) highlights that mining operations in rural areas often lead to the destruction of fertile agricultural land and the contamination of rivers, making it harder for communities to maintain their livelihoods. This economic disruption exacerbates poverty, as families who depend on farming and fishing for survival are forced to find alternative and often less sustainable sources of income. The decline in local economic stability increases social vulnerability, making communities more susceptible to further social and environmental risks.

Social conflicts also arise as mining activities increase competition for limited resources such as land, water, and labor. The influx of miners into rural areas often leads to tensions between residents and incoming workers, with disputes over land rights, resource allocation, and environmental damage. According to Veltz et al. (2020), conflicts related to mining can intensify community divisions, especially when miners and locals have competing interests over the use of natural resources. These social tensions can lead to violence, displacement, and long-term instability, making it difficult for affected communities to develop cohesive, sustainable solutions to the challenges posed by mining.

4. Based on the findings, what policies can be recommended to mitigate the negative effects of small-scale mining and promote safer, more sustainable practices in Barangay Pawa, Boac, Marinduque?

To mitigate the negative effects of small-scale mining and promote safer practices, implementing stricter environmental regulations is paramount. Policies that focus on better waste management, land rehabilitation, and pollution control are essential to limit the environmental impact of mining activities. A study by Smith et al. (2021) advocates for stricter enforcement of environmental protection laws in mining areas to reduce pollution and prevent long-term ecological damage. Strengthening the legal framework surrounding small-scale mining, including clear guidelines for waste disposal and resource management, will help protect local ecosystems and reduce health risks for nearby communities. Furthermore, the government should introduce incentives for mining operators to adopt cleaner, more sustainable technologies.

Health and safety policies must also be prioritized to reduce the risks miners face. Ensuring the availability of proper protective equipment, establishing health monitoring systems, and providing access to medical care for miners and surrounding residents can reduce the incidence of work-related diseases. According to Oliveira and Santos (2021), effective regulation of occupational health and safety standards is crucial to preventing the spread of respiratory diseases, skin conditions, and other health issues caused by exposure to toxic mining byproducts. The establishment of a robust health monitoring system, including regular checkups and emergency response plans, will contribute to safeguarding the health of workers in mining areas. In addition, training miners on best practices for personal protection and emergency response is crucial for reducing work-related injuries and illnesses.

Lastly, fostering community engagement and promoting alternative livelihoods will help build resilience in mining-affected communities. Policymakers should focus on economic diversification by supporting agriculture, small businesses, and eco-tourism as viable alternatives to mining. A study by Pimentel et al. (2020) stresses the importance of creating alternative livelihood programs for communities impacted by mining. These programs can provide training and resources to help residents transition to more sustainable income sources. In addition, strengthening local governance and

involving community members in decision-making processes will ensure that policies reflect their needs and priorities, leading to more sustainable and equitable outcomes for all.

CONCLUSION

This study sheds light on the complex and multi-dimensional impacts of small-scale mining in Barangay Pawa, Boac, Marinduque. The research clearly illustrates that while small-scale mining provides immediate economic relief and job opportunities for many individuals in the community, the longer-term consequences, particularly regarding health, environmental degradation, and social stability, are far-reaching and severe. Stakeholders' assessments of the mining activities indicate a high degree of concern over inefficient mining operations, environmental damage such as water contamination and deforestation, and inadequate health and safety protocols for miners. Water contamination emerged as the most critical issue, with severe implications for both human health and local ecosystems. The mining activities also posed a range of social risks, such as disruption of local livelihoods, displacement of families, and intensification of community conflicts, further exacerbating the vulnerabilities of this rural community. These findings underscore the need for urgent, proactive measures to address the negative consequences of small-scale mining while ensuring that it contributes positively to local development.

From an environmental perspective, the study underscores the findings of Hernández et al. (2021) and Dávila et al. (2022), who highlighted that small-scale mining, when not properly regulated, leads to significant ecological damage. The environmental consequences observed in Barangay Pawa, including deforestation, soil erosion, and water contamination, resonate with the broader literature on unregulated mining practices in developing countries. The contamination of water sources, in particular, is of critical concern as it poses severe health risks to both miners and surrounding communities. Garcia et al. (2020) pointed out that mining-induced water pollution often leads to a range of diseases, including waterborne illnesses, which disproportionately affect the most vulnerable populations. Furthermore, the disruption of natural habitats and agricultural lands not only affects biodiversity but also threatens food security and the livelihoods of local residents, who heavily rely on agriculture and fishing for survival.

Social risks tied to small-scale mining in Barangay Pawa also reflect larger patterns observed in other mining-affected areas globally. According to the Social Risk Theory, which posits that economic activities like mining can have both positive and negative consequences for communities depending on how they are managed, small-scale mining may initially provide economic benefits but may also lead to severe social and environmental costs if not properly regulated (Sengupta, 2022). In the case of Barangay Pawa, while mining provides short-term economic opportunities, it has long-term negative effects on community health, local economies, and social cohesion. The economic instability caused by the fluctuating nature of mining revenues has led to an over-reliance on mining, preventing the community from diversifying into more sustainable and stable livelihood options, such as agriculture or eco-tourism. Moreover, mining-related land disputes, resource conflicts, and displacement further destabilize the social fabric of the community, leading to increased social unrest and violence.

The results of this study also suggest that weak regulatory enforcement exacerbates these negative outcomes. Despite the presence of environmental and labor regulations, mining operators in Barangay Pawa often circumvent these laws, leading to unsustainable practices that harm both the environment and local residents. González et al. (2021) argue that weak enforcement of mining regulations leads to increased ecological degradation and workers' rights violations, which align with the findings from Barangay Pawa. The inconsistency of inspections and lack of penalties for non-compliance prevent

effective mitigation of the negative consequences of mining. To address these issues, the study highlights the need for stronger enforcement of environmental, health, and safety regulations, as well as the establishment of clear legal frameworks for resource management and land ownership.

In terms of economic impact, the study aligns with Pérez and Martínez (2023), who have argued that while small-scale mining provides immediate economic relief, it often fails to deliver long-term economic stability for communities. The community's dependence on mining has made it vulnerable to economic volatility, particularly given the unpredictable nature of global commodity markets. As mining operations become less sustainable due to resource depletion, economic instability becomes more pronounced, leaving communities in a perpetual state of uncertainty. The study calls for economic diversification through alternative livelihood programs that focus on agriculture, small business development, and eco-tourism, which can help reduce the community's dependence on the mining industry and promote long-term resilience.

Drawing on the theories of sustainable development and community resilience, this study reinforces the idea that small-scale mining should not be viewed in isolation. Instead, it must be integrated into a broader framework of sustainable development that considers both environmental conservation and socio-economic stability. Sustainable development theories, such as those proposed by Sachs (2021), emphasize the importance of balancing economic growth with environmental sustainability and social equity. In the context of Barangay Pawa, this means adopting practices that ensure the environment is preserved, while also supporting the community's economic and social needs. By focusing on sustainable mining practices, improving the regulatory environment, and diversifying the local economy, it is possible to mitigate the adverse effects of mining while ensuring that communities can thrive in the long term.

In conclusion, while small-scale mining in Barangay Pawa provides crucial economic benefits, its detrimental effects on the environment, public health, and social cohesion are undeniable. The study highlights the urgent need for more effective governance and stronger enforcement of regulations to mitigate these risks. The findings align with the broader literature on small-scale mining, which underscores the importance of sustainable mining practices, improved community engagement, and economic diversification in mitigating the negative impacts of mining. Through the application of the Social Risk Theory and sustainable development principles, the study calls for a multi-stakeholder approach that involves government agencies, mining operators, local communities, and civil society organizations working together to address the social, environmental, and economic risks posed by small-scale mining. By taking these actions, Barangay Pawa can shift towards more sustainable and equitable development, benefiting both the local community and the environment in the long term.

Recommendations

To address the multifaceted challenges posed by small-scale mining in Barangay Pawa, it is crucial to implement stronger regulatory frameworks and improve enforcement mechanisms. The government should prioritize the strengthening of environmental regulations, ensuring that all mining activities are properly licensed, monitored, and subject to regular inspections. Strict penalties for non-compliance should be enforced to deter illegal and irresponsible mining practices. Local government units (LGUs) should collaborate with environmental agencies to establish more robust monitoring systems, including environmental impact assessments, to ensure that mining operations adhere to sustainable practices. Additionally, there should be a focus on rehabilitating mining-affected areas, such as reforestation programs and water management strategies, to restore ecosystems and mitigate environmental degradation.

In terms of health and safety, a more comprehensive approach is needed to protect miners and surrounding communities. Policymakers must enforce occupational health and safety regulations,

ensuring that all miners have access to proper protective equipment (PPE) and medical support. A community-based health monitoring system should be established to regularly track the health conditions of both miners and nearby residents, with particular attention to respiratory diseases, skin conditions, and waterborne illnesses. Health services should be integrated into mining areas, with mobile clinics and emergency response teams available to provide immediate medical assistance. Training programs for miners on the importance of safety protocols and personal protective measures should be mandatory to reduce the risks of occupational diseases and accidents.

Lastly, diversifying the local economy is essential to reduce the community's over-reliance on small-scale mining, which contributes to economic instability. The local government should promote alternative livelihood programs that focus on sustainable industries such as agriculture, eco-tourism, and small-scale manufacturing. These industries not only provide stable sources of income but also help improve the community's resilience to the fluctuating demands of the mining industry. Support for entrepreneurial ventures, small businesses, and cooperatives could also empower the local population to create diversified economic opportunities. Moreover, developing partnerships with non-governmental organizations (NGOs) and private sectors to provide training, financial resources, and market access for alternative livelihoods can further reduce the social and economic risks associated with mining. A holistic approach that combines regulation, health and safety, and economic diversification can pave the way for sustainable development in Barangay Pawa and other mining-affected areas

The lowest mean of 2.97, interpreted as Agree, suggests that some users still experience occasional challenges with device compatibility. Although the value remains within the "Agree" range, it reveals slight inconsistencies in users' experiences. These minor issues could stem from outdated devices or varying system requirements. Addressing compatibility concerns could improve user trust and reduce transaction delays. This observation echoes findings that compatibility issues, even if infrequent, can discourage continued use of digital government services (Boateng et al., 2023).

The overall mean of 3.10, interpreted as Agree, shows that respondents generally possess sufficient digital knowledge to navigate the SSS e-GOV platform. This level of understanding enables users to complete transactions independently. The results indicate that most users can identify, interpret, and apply the steps required for digital processes. Such digital knowledge contributes to smoother service usage and reduced assistance needs. This aligns with the conclusion that digital awareness is a key driver of successful online service utilization (Rahman et al., 2022).

The highest mean of 3.18, classified as Agree, indicates that users understand the steps needed to complete SSS e-GOV transactions. This suggests that procedural comprehension is strong among respondents. Because users understand the process, they are more likely to finish tasks correctly and efficiently. This understanding promotes user satisfaction and reduces errors. Research highlights that a clear comprehension of digital procedures significantly enhances platform usability (Mills et al., 2021).

The lowest mean of 3.03, still interpreted as Agree, indicates slight uncertainty about respondents' familiarity with all platform functions. This indicates that users may not fully explore or understand advanced features. Limited familiarity could hinder their ability to benefit from digital services fully. Improving user guides and tutorials may address this gap. These findings parallel studies revealing that the lack of functional knowledge remains a subtle barrier to optimal digital service adoption (Bala & Singh, 2024).

REFERENCES

- Büscher, B., Arsel, M., & Smith, M. (2020). Mining and the politics of environment in sub-Saharan Africa. *Journal of Environmental Management*, 72(2), 179-195. <https://doi.org/10.1016/j.jenvman.2019.04.004>
- Costa, S., Silva, D., & Rodrigues, F. (2022). Small-scale mining and sustainable development: A social and environmental analysis. *Environment and Development Economics*, 27(3), 303-318. <https://doi.org/10.1017/S1355770X22000042>
- Dávila, J. M., González, M., & Hernández, A. (2022). Environmental impact of small-scale mining in developing countries: Evidence from Latin America. *Ecological Economics*, 103, 35-42. <https://doi.org/10.1016/j.ecolecon.2021.106785>
- García, A., Torres, R., & Mendoza, C. (2020). Water contamination and public health risks from small-scale mining in Southeast Asia. *Environmental Health Perspectives*, 128(7), 107-114. <https://doi.org/10.1289/EHP764>
- González, M., Pérez, A., & López, J. (2021). Challenges to effective regulatory compliance in small-scale mining in the Philippines. *Environmental Law Review*, 43(1), 112-125. <https://doi.org/10.1016/j.enlaw.2020.10.006>
- Hernández, F., Larrauri, R., & Dávila, J. M. (2021). Ecological risks of small-scale mining in rural regions: A case study from the Philippines. *Environmental Science and Policy*, 107, 47-53. <https://doi.org/10.1016/j.envsci.2020.12.004>
- Ibrahim, M., Veltz, P., & Rodríguez, J. (2021). Mining and its effects on traditional rural livelihoods: Evidence from the Philippines. *Rural Development Studies*, 39(4), 183-197. <https://doi.org/10.1016/j.rurdev.2021.02.002>
- Jara, M., López, M., & García, A. (2020). Health risks and safety practices in small-scale mining communities. *Occupational Health and Safety Journal*, 33(2), 107-113. <https://doi.org/10.1007/s12904-019-00392-w>
- Liu, W., Zhang, L., & Santos, P. (2022). The impact of mining on food security: A global overview. *Agricultural Economics Review*, 23(3), 12-18. <https://doi.org/10.1016/j.agricultres.2021.06.003>
- López, L., Vargas, M., & Tan, J. (2021). Enhancing the health and safety standards for miners: A policy review of small-scale mining practices. *Journal of Public Health Policy*, 42(1), 65-72. <https://doi.org/10.1057/s41271-021-00358-5>
- Mathews, J., Tang, M., & Rodriguez, D. (2021). Operational challenges in small-scale mining: The need for technical expertise and community engagement. *Mining Journal*, 58(4), 71-79. <https://doi.org/10.1016/j.mineng.2020.11.009>
- Pérez, A., & Martínez, F. (2023). Economic volatility and small-scale mining: Implications for community resilience. *Journal of Rural Economics*, 40(5), 29-34. <https://doi.org/10.1080/14693017.2022.1801432>
- Pimentel, D., Oliveira, T., & Santos, J. (2020). Diversifying livelihoods to reduce dependence on mining: A framework for rural communities. *Development Policy Review*, 38(5), 691-705. <https://doi.org/10.1111/dpr.12556>
- Rodríguez, F., García, M., & Fernández, A. (2022). Displacement and resettlement in mining areas: Social implications in developing countries. *Journal of Human Development*, 31(3), 312-320. <https://doi.org/10.1080/14649888.2022.1824851>

- Smith, T., & Harris, N. (2021). The health impacts of small-scale mining: An overview of global trends and responses. *Global Health*, 12(2), 112-118. <https://doi.org/10.1186/s12992-021-00753-1>
- Tan, J., Lee, M., & Büscher, B. (2021). Policy gaps and health risks in small-scale mining: A case study from Southeast Asia. *Policy Studies Review*, 24(4), 131-142. <https://doi.org/10.1111/psr.12301>
- Torres, M., Sánchez, L., & Martínez, P. (2022). Promoting economic diversification in small-scale mining regions. *Economic Development Quarterly*, 35(2), 220-232. <https://doi.org/10.1177/08912424221107781>
- Veltz, P., Sorell, B., & Ibrahim, M. (2020). Mining and social conflict: A comprehensive review of land disputes and resource allocation in developing countries. *Global Environmental Change*, 62, 102085. <https://doi.org/10.1016/j.gloenvcha.2020.102085>
- Zhang, T., Liu, H., & Tan, L. (2021). Land restoration and food security in mining-affected regions. *Environmental Restoration Journal*, 16(4), 43-50. <https://doi.org/10.1016/j.envres.2021.101658>