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Evaluation of Landslide Disaster Management in Sawahlunto

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ABSTRACT

Sawahlunto City had a high level of landslide vulnerability due to its hilly topography with steep slopes and clay-dominated sedimentary geological conditions. These characteristics made the area highly susceptible to prolonged heavy rainfall, which acted as the main trigger for landslides. In response, the Regional Disaster Management Agency (BPBD) of Sawahlunto implemented disaster management efforts in the pre-disaster, during-disaster, and post-disaster phases. To evaluate the effectiveness, strengths, and weaknesses of these efforts, an evaluation was conducted along with the formulation of alternative strategies for landslide disaster risk reduction. This study employed a qualitative approach, based on interviews with 26 respondents, including relevant agency representatives and affected community members. A SWOT analysis was used to evaluate disaster management activities by identifying internal (strengths and weaknesses) and external (opportunities and threats) factors. The data were analyzed using thematic analysis to identify key themes based on similarities in the respondents' statements. The results indicated several strengths, including disaster education programs, the Sitaruna Darling initiative, hazard warning signs, risk assessment documents, community forums, and inter-agency collaboration. Weaknesses included limited structural mitigation, poor drainage management, unregulated development, uneven distribution of disaster education, gaps in the formation of Disaster Resilient Villages, damaged early warning systems, and limited financial and human resources of BPBD. Opportunities involved community interest in disaster education, village fund allocation, technological utilization, a strong local cooperation culture, and potential support from BNPB and local parliament programs Major threats included prolonged high-intensity rainfall, unstable topographic and geological conditions prone to landslides, and low public understanding of landslide disaster risks. The recommended strategies involved enhancing inter-agency synergy, optimizing structural mitigation, strengthening regulations, ensuring equal access to disaster education, developing Sitaruna Darling innovations, improving early warning systems, and utilizing BNPB grants for recovery efforts.

Keywords: *Landslide, Disaster Management; SWOT Analysis; Thematic Analysis; Risk Reduction Strategy.*

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INTRODUCTION

Sawahlunto City is located in a highland region that forms part of the Bukit Barisan Mountain Range, with more than 26.5% (72.47 km²) of its area consisting of hilly terrain and protected forests. The city is known as the "cauldron city" due to its basin-like geographical shape [1]. Historically, Sawahlunto has been recognized as a coal mining city, particularly due to the

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presence of the Ombilin Coal Mining Unit under Bukit Asam (PTBA-UPO), one of the largest mining operations in the region [1]. Its hilly topography, steep slopes, and soil conditions—degraded by former mining activities—make Sawahlunto highly vulnerable to natural disasters, particularly landslides [2].

Landslides in Sawahlunto are generally triggered by natural geomorphological conditions which, when combined with high rainfall intensity and duration, significantly increase the potential for ground movement in hazard-prone areas. Based on the 2023 Disaster Risk Assessment, the landslide hazard area in Sawahlunto covers approximately 2,552.76 hectares, comprising 0.18 hectares of low hazard, 1,636.47 hectares of moderate hazard, and 916.11 hectares of high hazard zones [2]. Historical data show a notable trend in landslide occurrences, with 130 incidents recorded in 2015, 123 in 2018, 136 in 2019, and 55 in 2021 [3]. Of the total landslide events from 2015 to 2018, 48 incidents occurred in Barangin District, which is identified as the most vulnerable area [4]. These facts indicate that landslides are recurring disasters that continue to threaten the safety and sustainability of local communities in Sawahlunto.

The urgency of this study increases in line with Sawahlunto's transformation from a mining city into a world heritage tourism city. The Ombilin Coal Mine was officially designated as a UNESCO World Heritage Site under the name Ombilin Coal Mining Heritage of Sawahlunto, and is one of 36 nominated sites globally [5]. This transformation presents new challenges in disaster risk management, particularly in balancing environmental conservation efforts with the sustainable development of tourism infrastructure. Given its complex geological and topographical characteristics, along with the expansion of settlements into high-risk areas, Sawahlunto demands special attention in disaster risk mitigation planning [2].

Although local government efforts to address disaster risks have been made, current policy implementation is not yet fully grounded in systematic and comprehensive planning. Many programs remain suboptimal and reactive in nature [2]. This condition underlines the need to enhance institutional capacity, strengthen disaster risk reduction policies, and improve the quality and consistency of disaster management activities at the local level.
Several previous studies on landslide disaster management in Sawahlunto have focused solely on non-structural mitigation aspects, such as the implementation of the Disaster-Resilient Village (Destana) program [4]. as well as risk mapping using ArcToolbox methods as part of community service activities [6].

However, no study has yet comprehensively evaluated all stages of disaster management. Therefore, this study aims to conduct an evaluation using the SWOT analysis approach to identify the strengths, weaknesses, opportunities, and threats present. This approach allows the formulation of adaptive strategies for reducing landslide disaster risks in Sawahlunto City [7].

METHOD

Research Design

This study employed a qualitative descriptive approach to explore the implementation of landslide disaster management in Sawahlunto City. The research aimed to identify patterns and strategic elements within disaster management activities by analyzing stakeholders' experiences and perspectives.

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Data Collection Technique

Primary data were collected through in-depth interviews. Respondents were selected using purposive sampling, focusing on individuals who hold relevant authority, responsibility, and involvement in landslide disaster events and management in Sawahlunto. In total, 26 respondents were interviewed, including representatives from key government agencies and members of the affected community. The institutional respondents consisted of officials from the Regional Disaster Management Agency (BPBD) of Sawahlunto, including the Head of BPBD, the Prevention and Preparedness Division, the Emergency Division, and the Rehabilitation and Reconstruction Division. Additional interviews were conducted with the Department of Public Works and Spatial Planning (PUPR), including the Head of Department, Bina Marga Division, Spatial Planning Division, and UPTD Heavy Equipment, all of whom are directly involved in emergency response. The Social Service Department was also interviewed through members of the Disaster Preparedness Cadets (Tagana). To assess public perceptions of the impacts and accuracy of disaster response policies, interviews were conducted with 11 community members from affected areas. Each institution received a different set of questions based on its duties and authority. The interview guide was structured according to a SWOT framework, aiming to identify the strengths, weaknesses, opportunities, and threats in the implementation of landslide disaster management.

Data Analysis Technique

Data analysis employed a thematic analysis approach [8], suitable for qualitative data such as interview results. The analysis began with transcribing each interview, followed by careful reading to gain an in-depth understanding of the content. The researcher then conducted coding by categorizing data into relevant groups based on the structured interview questions. These codes were either descriptive or conceptual. Once coding was complete, the researcher identified themes or patterns, particularly repeated phrases or keywords found across responses. The identified themes were then reviewed to ensure their consistency, relevance, and validity. Each theme was named according to its core content. Following validation of the thematic structure, the final step involved compiling the research findings into a coherent narrative that addressed the study's objectives.

RESULTS AND DISCUSSION

Evaluation Management Landslide Disaster

The evaluation was conducted on disaster management activities that have been implemented in Sawahlunto City, including the programs that have been executed as well as the policies and coordination carried out by agencies involved in landslide disaster management. This evaluation employed a SWOT analysis approach by outlining internal factors, including strengths and weaknesses of disaster management activities, and external factors in the form of opportunities and threats. The data used as the basis for the evaluation were analyzed using thematic analysis to identify sub-themes and main themes, which were then integrated into the SWOT framework through a SWOT matrix.

Internal Factors

In the evaluation of landslide disaster management, internal factors refer to the parties who have the authority and are involved in disaster management activities, namely the Sawahlunto City BPBD, the PUPR Service and Tagana. These factors are identified by assessing the strengths and weaknesses of the disaster management activities carried out.

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External Factors

The implementation of landslide disaster management in Sawahlunto City is influenced by external factors, such as community involvement and other aspects beyond the agency's control. These external factors include opportunities and threats, which can be assessed to develop alternative strategies for enhancing the effectiveness and optimization of disaster management implementation by the local government.

Table 1. SWOT Matrix

SWOT		THEME
Internal Factors	Strength	Disaster Education Program
		Sitaruna Darling Environmental Initiative
		Disaster risk assessment document
		Community-Based Forum Program in Enhancing Disaster Preparedness
		Collaboration of Agencies in the Disaster Emergency Response Phase
		Inter-Agency Collaboration in the Post-Disaster Rehabilitation and Reconstruction Phase
	Weakness	Limited Implementation of Structural Mitigation in Sawahlunto City
		Limited reach and distribution of outreach and socialization to the community
		Weak Regulations and Permits
		Limited Outreach of Disaster Education and Public Awareness Programs
		Malfunction of the Landslide Early Warning System
		Limitations of Personnel and Equipment in the Implementation of Emergency Response during Large-Scale Landslide Disasters
		Limited Budget Allocation for Post-Disaster Rehabilitation and Reconstruction Activities
External Factors	Opportunities	High Demand for Disaster Education Among the Community
		Support from Provincial and Central Governments in Database and Spatial Planning Maps
		Availability of Funds Allocated by the Village Government
		The Willingness of the Community to Receive Preparedness Training for Facing Landslides
		Availability of Communication Technology within the Community
		The Local Community's Culture of Mutual Cooperation
		Equipment Assistance and Borrowing from Mining Companies
		Funding Support for Rehabilitation and Reconstruction from BNPB
		Utilization of Pokir Fund Assistance
	Threats	High intensity rainfall with long duration
		Topographical and geological conditions threaten landslides

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Figure 1. SWOT

Pre – Disaster Activities
Disaster Mitigation
Strength
Theme: Disaster Education Program

Disaster education is one of the non-structural mitigation efforts aimed at enhancing community capacity to recognize risks and take appropriate actions in the event of a disaster. In the context of Sawahlunto City, which is geographically prone to landslides, this approach plays a vital role in strengthening public understanding of disaster risk and building preparedness at the community level. The disaster education activities carried out by BPBD Sawahlunto include the following:

Disaster Risk Counseling

One of the main initiatives implemented by BPBD Sawahlunto is disaster risk counseling and socialization, aimed at increasing public awareness and preparedness regarding landslide hazards. These activities are conducted with a focused approach, targeting areas with high levels of landslide vulnerability, based on risk mapping and technical assessments. The location selection is strategic to ensure that education reaches the most at-risk communities. The primary objective of these sessions is to improve public understanding of landslide risks and

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enhance their ability to recognize early warning signs such as soil cracks or slope movements. This initiative aligns with the principles of Community-Based Disaster Risk Reduction (CBDRR), where education and public participation form the foundation for community resilience[9].

Figure 2. Disaster Risk Counseling At Salak Village

Landslide Warning Sign Installation as a Visual Education Medium

The installation of warning signs and educational banners by BPBD Sawahlunto represents a strength in non-structural mitigation, as it allows the dissemination of risk information across various layers of society. These visual media serve as effective risk communication tools, especially in areas not fully reached by direct counseling efforts. The warning signs typically contain information about landslide-prone zones, while banners promote environmental stewardship, such as tree planting in critical areas.

The presence of these signs and banners is a strength because they deliver simple yet essential messages in a consistent manner without requiring direct interaction. This strategy reflects an inclusive communication approach, considering the limitations in literacy and access to formal education among some community members. Therefore, this initiative can be seen as a strength in building collective awareness and serves as a significant complement to formal disaster education strategies**.**

Theme: Sitaruna Darling Environmental Initiative

Sitaruna Darling is a local environmental initiative developed by the Sawahlunto City Government as part of non-structural disaster mitigation efforts, particularly in response to landslide risks. This program promotes environmentally responsible behavior through routine activities such as disposing of waste properly, maintaining drainage channels to prevent blockages, and organizing scheduled communal clean-up events. These activities are implemented across both community and government levels. Sitaruna Darling is one of ecosystem-based disaster risk reduction (Eco-DRR) approaches, which include such community-led environmental management practices, have been recognized for their effectiveness in reducing disaster risks and enhancing resilience [10].

Clean-up activities within local government agencies (Organisasi Perangkat Daerah/OPD) are supervised directly by each agency head, while those at the community level are coordinated by village authorities with support from the Disaster Preparedness Groups (KSB). The program

also includes tree-planting activities in landslide-prone areas as a form of environmental conservation and slope stabilization.

The strength of this initiative lies in its participatory and collaborative approach, involving stakeholders across multiple sectors. It strengthens community awareness and resilience through consistent, practical actions aligned with the city's disaster risk context. The program also reflects the principles of community-based mitigation, where behavioral change and active community involvement are central to achieving long-term disaster risk reduction.

Theme: Disaster Risk Assessment Document

The disaster risk assessment document developed by the Regional Disaster Management Agency (BPBD) of Sawahlunto City aims to identify high-risk areas, particularly those prone to landslides. This document serves as a vital instrument to support decision-making related to disaster risk reduction, as well as a foundational reference for formulating mitigation policies and sustainable spatial planning. In addition, it provides guidance for local governments in designing infrastructure development that aligns with disaster safety standards.

The document includes several key components, such as landslide hazard maps, spatial planning data, and analysis of the city's geographical and geological conditions. Its existence strengthens the integration between spatial planning and mitigation strategies, as recommended in evidence-based disaster risk reduction practices. Therefore, the risk assessment document functions not only as a technical report but also as a strategic tool for building regional resilience.

Weakness

Theme: Limited Implementation of Structural Mitigation in Sawahlunto City

One of the significant weaknesses in disaster management in Sawahlunto City is the suboptimal implementation of structural mitigation efforts in landslide-prone areas. The Department of Public Works and Spatial Planning (PUPR), as the authorized technical agency, faces challenges in realizing mitigation-based infrastructure projects due to limited budget allocation. As a result, programs such as slope stabilization, construction of gabions, and other protective infrastructure have not been implemented comprehensively in all priority areas.

This issue is exacerbated by the poor condition and inadequate design of drainage systems. Blocked or disconnected drainage channels contribute to soil saturation during heavy rainfall, which in turn increases landslide risk. The lack of disaster-informed design in drainage planning has become a technical vulnerability that heightens overall exposure.

Moreover, infrastructure and housing developments in hazard-prone areas are often carried out without sufficient geotechnical risk assessments. The absence of disaster risk analysis in the planning phase reflects a weak application of disaster risk-informed development principles. This practice contradicts the "build back better" approach promoted in the Sendai Framework for Disaster Risk Reduction, which emphasizes that all forms of development should incorporate elements of sustainability and safety from disaster threats.

Theme: Limited Outreach of Disaster Education and Public Awareness Programs

One of the key weaknesses in landslide disaster management in Sawahlunto City is the unequal outreach of disaster education programs to all villages and sub-districts. Counseling and public awareness activities, which are supposed to serve as the main instruments in building

community preparedness, have not yet reached all at-risk areas. As a result, a portion of the population lacks sufficient understanding of landslide hazards and the mitigation measures that can be taken independently.

This limitation is closely related to the suboptimal operational capacity of the Regional Disaster Management Agency (BPBD), particularly in terms of the number of personnel assigned to educational outreach and the limited allocation of resources to support these activities. This situation affects the frequency and coverage of educational efforts, which in turn impacts the community's readiness to recognize early warning signs, respond to alerts, and take swift and appropriate evacuation actions.

The lack of comprehensive outreach also contradicts the principle of inclusiveness in disaster risk reduction, which emphasizes the importance of involving all layers of society without exception. As highlighted by UNDRR (2019), disaster education must be continuous and contextual in order to build resilient and adaptive communities in the face of disaster risk[11].

Theme: Weak Regulations and Permits

The weakness of existing regulations and authority hinders the effectiveness of disaster management activities in Sawahlunto City. This includes the lack of enforcement of spatial planning policies, unregulated development in hazard-prone areas, and the absence of structured contingency plans. Inadequate, unclear, or poorly implemented regulations can lead to confusion between agencies, as well as reduce the effectiveness of task execution and coordination.These regulatory gaps limit inter-agency coordination and reduce the effectiveness of mitigation efforts. This concern is also emphasized in the Sendai Framework for Disaster Risk Reduction (2015–2030), which highlights the importance of strong and coherent local regulations to ensure that land use planning and development activities are risk-informed. The framework stresses that effective governance and regulatory frameworks are crucial for minimizing exposure to hazards and ensuring resilience at the local level [12].

Interviews with respondents revealed that this issue encompasses several aspects, including:

the lack of enforcement of spatial planning regulations and building permits, which increases vulnerability to disasters

the absence of organized infrastructure data, complicating mitigation and emergency response efforts

the lack of a clear contingency plan, leaving the BPBD (Regional Disaster Management Agency) and related agencies without sufficient guidelines to respond to disasters in a structured manner

limited implementation of the Disaster Mitigation Plan (RPB), which should serve as a reference for mitigation and disaster management activities

the limited distribution of policies, which hinders understanding and implementation of disaster management policies at the community and local government levels. These findings suggest the need for stronger, clearer, and more integrated regulations, as well as enhanced coordination among agencies, to improve the effectiveness of disaster management in Sawahlunto City.

Opportunity

Theme: High Demand for Disaster Education Among the Community

The community in Sawahlunto City has shown a high level of awareness regarding the importance of basic knowledge about disasters, particularly related to landslide risks. Based on the interview results, the majority of the community expressed a desire to receive counseling

and socialization about disaster mitigation. This awareness indicates that the community is ready to play an active role in reducing the risk of landslides. Improved disaster literacy can enhance the community's capacity to identify warning signs, understand mitigation measures, and know the proper emergency response procedures.

Effective education can strengthen the community's capacity to face disasters and expedite the response process. Therefore, continuous, community-based educational activities that involve the community directly are crucial. Although there is strong demand from the community for education, it is essential to evaluate the extent to which existing educational programs can meet these needs, as well as the challenges faced in their implementation. Thus, the development of more integrated and locally-based educational programs is necessary to improve the effectiveness of landslide disaster mitigation in Sawahlunto City.

Theme: Support from Provincial and Central Governments in Database and Spatial Planning Maps

One of the opportunities that can be utilized in the development of the Regional Spatial Planning (RTRW) for Sawahlunto City is the support from the Provincial and Central Governments in the preparation of databases and spatial planning maps. This support is crucial in enhancing the quality of data used in disaster mitigation planning, particularly related to urban spatial planning. Through assistance from the Provincial and Central Governments, the Public Works and Spatial Planning Office (PUPR) can obtain accurate geospatial data, Geographic Information System (GIS) software, and qualified experts to help in the preparation of spatial planning maps and disaster risk maps in more detail.

The existence of an integrated database, combining local data with national policies, can accelerate data-driven planning processes and enhance the effectiveness of disaster mitigation policies. Therefore, strengthening cooperation between local governments and the central government in the provision and management of geospatial data is a key step to ensure data-driven development that is more effective and responsive to disaster risks in Sawahlunto City.

Disaster Preparadness

Strength

Theme: Community-Based Forum Program in Enhancing Disaster Preparedness

As part of the continuity of disaster education and public awareness efforts, the Regional Disaster Management Agency (BPBD) of Sawahlunto City has developed a structured community-based forum program. This initiative is designed to increase community resilience and independence in disaster preparedness and response, particularly for landslide hazards.

Disaster Resilient Village (Destana)

The Destana program serves as the backbone of community-based disaster risk reduction by integrating all disaster phases—pre-disaster, emergency, and post-disaster—into village governance and development. Activities carried out within Destana include the development of village disaster management plans (Perdes), mapping of disaster risk areas, planning of evacuation routes, conducting independent evacuation drills, designing evacuation shelters, and establishing emergency communication systems. This initiative promotes resilience by empowering local communities to manage disaster risks independently. According to the National Disaster Management Agency (BNPB), the establishment of Destana is a strategic initiative to increase community preparedness, foster participatory mitigation, and reduce vulnerability through locally-led disaster risk management mechanisms [13].

Destana functions as an extension of BPBD in enhancing community capacity. Currently, four Destana units have been established across the city: Rantih Village (Talawi District), Lumindai Village (Barangin District), Kubang Tangah Village (Lembah Segar District), and Silungkang Oso Village (Silungkang District). In particular, the Destana in Lumindai Village has demonstrated a high level of success, where the local community is capable of managing disaster responses independently, requiring minimal intervention from BPBD.

Destana Jamboree Activities

BPBD organizes the Destana Jamboree as a platform for evaluation, simulation, and capacity building for Destana members. This activity includes simulation of landslide disaster scenarios, training on pre-disaster planning, evacuation strategies during disaster events, identification of alternative evacuation routes, and techniques for community recovery. Additionally, experts in landslide mitigation are invited to provide technical insights, further strengthening community competence in disaster response.

Disaster Preparedness Groups (KSB)

KSB are small-scale preparedness groups formed within villages or neighborhoods to enhance local capacity in disaster anticipation and response. Typically consisting of members from one or more hamlets, KSB members receive specific training in preparedness and rapid response. In Sawahlunto, each Destana includes at least one KSB unit that supports localized early warning and emergency management efforts.

Safe School Program (SPAB)

BPBD also implements the Safe School Program (SPAB) in primary and junior high schools throughout Sawahlunto City. This program is designed to build disaster preparedness among school communities through awareness campaigns, evacuation drills, simulation exercises, and the development of school emergency response plans. Teachers, staff, and students are actively involved in forming school-based emergency response teams to ensure safety and rapid coordination during disaster events. The program especially emphasizes the role of teachers as facilitators of safety during emergencies.

Weakness

Theme: Limited Establishment of Community-Based Disaster Forums

One of the notable weaknesses in disaster management implementation in Sawahlunto City is the limited establishment of Disaster Resilient Villages (Destana) across all villages and urban neighborhoods. While BPBD has initiated Destana in selected locations, the program has not yet been implemented comprehensively throughout the entire administrative area. This condition stems from various constraints, particularly limited financial and human resources allocated for program expansion.

The uneven distribution of Destana has led to disparities in disaster preparedness capacity among communities. Villages without Destana tend to lack structured disaster planning, community-based risk assessments, and access to routine education or simulation activities. Consequently, these communities remain dependent on external assistance and are less equipped to respond independently during disaster events.

Moreover, the absence of widespread community-based forums hinders participatory approaches in disaster management, where ideally, local residents should play an active role

not only in disaster response but also in mitigation and preparedness planning. The current condition highlights the need for a more inclusive and scalable strategy to replicate successful models like Lumindai's Destana, ensuring that disaster management programs are not centralized or limited to pilot areas only, but equitably implemented city-wide.

Theme: Malfunction of the Landslide Early Warning System

One of the major weaknesses in landslide preparedness efforts in Sawahlunto City is the malfunctioning of the early warning system that was previously installed in landslide-prone zones. This system consisted of ground movement detection devices intended to alert residents of potential landslide threats. However, these devices have become inoperative due to theft of components, technical damage, and the lack of regular maintenance.

The loss of this critical tool for disaster mitigation has significantly reduced the city's capacity to issue timely warnings, thereby compromising the ability of local communities to evacuate promptly. The absence of alarm signals increases the risk of delayed responses, potentially leading to greater casualties and property damage when a disaster occurs. Efforts to restore the system have been hindered by substantial financial constraints. The high cost of equipment procurement and maintenance, combined with limited budget allocations within the Regional Disaster Management Agency (BPBD), has prevented the agency from repairing or replacing the damaged devices. Moreover, there is a lack of collaborative funding schemes between the municipal, provincial, and central governments to support long-term technological solutions.

This issue highlights the critical need for integrating technology, budget planning, and community involvement in maintaining and operating early warning systems. Without a reliable and sustainable warning mechanism, community preparedness for landslide disasters will remain insufficient and vulnerable.

Opportunity

Theme: The Willingness of the Community to Receive Preparedness Training for Facing Landslides

A significant portion of the population in Sawahlunto expressed a strong desire to receive training and preparation for landslide disasters. This willingness reflects an opportunity to enhance the capacity of the community, particularly those residing in landslide-prone areas. The desire for training also demonstrates an increasing awareness of the importance of disaster mitigation to protect oneself, family, and the surrounding environment.This desire for training is a continuation of previous outreach and socialization activities conducted by the authorities. The outreach activities aim to provide sufficient information to the public on the necessary mitigation steps to take when a landslide occurs. As a result of these outreach efforts, the community has become more aware of the importance of preparedness, which has encouraged them to form community-based disaster management forums.

Community-based disaster management forums, such as Disaster-Resilient Villages (Destana) and Disaster-Preparedness Groups (KSB), serve as a platform for the continuation of these outreach and socialization activities. The formation of these forums provides opportunities for community members to actively participate in planning and implementing mitigation measures at the local level. These forums empower the community with the knowledge, skills, and capacity to independently face disasters and contribute to post-disaster recovery efforts.

This opportunity also demonstrates the great potential for active community involvement as a

vital element in disaster management. By establishing community-based disaster management forums, the community can engage directly in disaster risk reduction, strengthen preparedness, and enhance local resilience. Over time, these forums can become an integral part of the broader disaster risk management system in Sawahlunto, supporting community resilience and reducing the impacts of landslides.

Theme: Availability of Communication Technology within the Community

The use of mobile phones significantly facilitates communication between the community and the Sawahlunto City Government, particularly through technologies such as websites and the WhatsApp messaging application. These technologies enable the rapid and wide dissemination of early warning information, allowing the community to quickly become aware of potential threats and take necessary mitigation or evacuation actions. Communication technologies, particularly mobile and digital platforms, play a critical role in supporting early warning dissemination and enhancing community responsiveness during crises[14].

Moreover, mobile technology provides a platform for the community to report early signs of landslides or other disaster events directly to the government or the BPBD (Regional Disaster Management Agency). This capability enables citizens to communicate emergency situations, request rescue teams, or seek other forms of assistance. Consequently, disaster response can be carried out more efficiently, enabling faster and more accurate actions to minimize the impact of the disaster.The availability of communication technology within the community serves as a crucial asset in enhancing disaster preparedness and response, improving coordination between the public and authorities, and reducing the time required for intervention during disaster events.

Theme: Availability of Funds Allocated by the Village Government

The Village Government independently manages its budget through the Village Revenue and Expenditure Budget (APB Desa). This budgeting system is regulated by Law No. 6 of 2014 on Villages and Government Regulation No. 43 of 2014. Within the APB Desa, funds are allocated for disaster-related activities. Although the amount allocated is not substantial for the development of mitigation-based infrastructure, it can be utilized for disaster management activities such as community education and training. According to Article 67 letter b of Law No. 6 of 2014, one of the village's obligations is to develop the community's capacity, which includes providing education, training, and awareness related to disaster preparedness. This legal mandate supports the allocation of village funds for empowering communities in disaster risk reduction efforts[15].

Respondents involved in village governance emphasized that the allocation of these funds represents a significant opportunity to overcome budget limitations for the establishment of community-based disaster management forums in the villages of Sawahlunto City. By integrating disaster preparedness activities into the Village Work Plan (RKP Desa), these initiatives can be prioritized and incorporated into the village's development strategy. This approach not only addresses budget constraints but also aligns with community needs, ensuring that disaster management efforts are sustained and integrated within the local governance framework.

Thus, the allocation of funds for disaster-related activities in the APB Desa provides a practical avenue for strengthening community resilience and enhancing disaster preparedness at the village level. This opportunity can contribute to the establishment of community-based disaster

management forums, which are essential for improving disaster risk reduction and response capacities in Sawahlunto City.

Disaster Emergency Response
Strength
Theme: Collaboration of Agencies in the Disaster Emergency Response Phase
During a disaster, the BPBD (Regional Disaster Management Agency) functions as the implementer and command center. In Sawahlunto, effective cooperation and coordination have been established between agencies involved in disaster emergency response. The procedures followed during a disaster are as follows: BPBD receives reports from the community about the occurrence of a disaster, after which BPBD conducts a field assessment to determine whether the disaster is of small-scale or massive proportions. BPBD maps the affected areas using drones. BPBD will coordinate and collaborate with relevant agencies in the case of a large-scale disaster, while smaller-scale disasters are managed independently by BPBD.

In the event of a massive disaster, BPBD will declare a state of emergency, form response teams, and set up evacuation posts within a maximum of 24 hours. This declaration serves as the legal framework for coordinating with other agencies in disaster management. Field coordination among agencies includes the provision of heavy equipment, cleaning up debris, conducting initial observations and assessments with the Public Works and Housing Office (Dinas PUPR), checking the condition of landslide victims by the Health Service (Dinas Kesehatan), distributing logistics, setting up communal kitchens, evacuating victims, and establishing disaster posts to meet the basic needs of affected communities. These efforts are carried out by the Social Services Agency (Dinas Sosial) through its Tagana (Disaster Response Team).

Weakness
Theme: Limitations of Personnel and Equipment in the Implementation of Emergency Response during Large-Scale Landslide Disasters
One of the main weaknesses in the emergency response phase of landslide disaster management in Sawahlunto City lies in the limited resources of the Regional Disaster Management Agency (BPBD), particularly in terms of personnel and equipment. The limited number of BPBD personnel poses a significant challenge when landslide events occur simultaneously at multiple locations, especially during periods of high rainfall intensity. Under such conditions, BPBD struggles to reach all affected areas evenly, necessitating the implementation of a prioritization system. Areas with the most severe impacts and those posing the greatest threat to public safety are given priority, while others experience delays in response.

This prioritization often leads to a perception of inequality among affected residents, particularly those whose homes were not addressed immediately. Many residents expressed disappointment, believing that emergency efforts prioritized public infrastructure over individual household needs. These delays contribute to reduced public trust in BPBD’s capacity to effectively manage disaster response operations.

In addition to personnel shortages, the lack of adequate emergency response equipment further hampers BPBD's ability to respond effectively. The agency does not have sufficient tools, such as heavy machinery and essential field equipment, to access and manage all disaster locations at once. This equipment gap results in delayed evacuation processes, prolonged debris clearance, and slower distribution of relief aid to affected communities.

Overall, the limitations in personnel and equipment highlight the need to strengthen BPBD Sawahlunto's institutional capacity. Enhancing human resources and logistical capabilities is crucial to ensuring an effective, timely, and equitable emergency response, particularly in the face of large-scale disasters affecting multiple areas simultaneously.

Opportunity

Theme: The Local Community's Culture of Mutual Cooperation

he strong tradition of mutual cooperation (gotong royong) among the people of Sawahlunto serves as a significant opportunity in the implementation of emergency response activities during landslide disasters. According to statements from BPBD personnel, the affected communities have demonstrated a high level of collective spirit by voluntarily assisting emergency responders and BPBD officers during disaster events. This includes helping clear landslide debris, assisting in the evacuation of affected residents, and restoring access to roads blocked by landslides.

Such active community participation has proven effective in accelerating field response efforts and alleviating the workload of the limited BPBD personnel. This mutual cooperation culture not only reflects strong social values but also becomes a vital asset in strengthening community-based disaster management. Community involvement during the emergency response phase illustrates their growing awareness, concern for their surroundings, and willingness to collaborate in urgent situations.

Theme: Equipment Assistance and Borrowing from Mining Companies

The availability of disaster response equipment from external parties, particularly mining companies, represents a strategic opportunity to optimize emergency response efforts for landslides in Sawahlunto City. Based on interviews with BPBD personnel, it was revealed that collaboration has been established with mining companies operating in the area, especially during large-scale disasters. Through a mechanism of borrowing heavy equipment and other evacuation tools, BPBD is able to accelerate emergency response operations in the field.

The equipment provided by the mining companies is generally used for evacuation purposes, clearing landslide debris that blocks access roads, and restoring temporary evacuation routes. This collaborative effort is crucial considering the limitations in personnel and equipment faced by BPBD, particularly when responding to disasters that occur simultaneously at multiple locations. The availability of additional resources from mining companies enables a faster and more effective response, thereby reducing the risk of casualties and material losses.

This opportunity reflects the importance of cross-sectoral synergy in disaster management, where the private sector plays an active role in supporting the government's efforts to protect communities. With this partnership, emergency response processes can be carried out more efficiently and sustainably.

Post Disaster Phase (Rehabilitation and Reconstruction)

Strength

Theme: Inter-Agency Collaboration in the Post-Disaster Rehabilitation and Reconstruction Phase

Inter-agency collaboration serves as a significant strength in the implementation of post-disaster rehabilitation and reconstruction efforts in Sawahlunto City. During this phase, the

Regional Disaster Management Agency (BPBD) of Sawahlunto acts as a coordinator that facilitates coordination and synergy with various technical agencies involved in infrastructure and housing recovery.

BPBD holds the authority to provide recommendations to implementing agencies, particularly those responsible for public infrastructure and community settlements. The main agencies involved include the Department of Public Works and Spatial Planning (PUPR) and the Department of Housing, Settlement Areas, Land Affairs, and Environment (PERKIMTAN LH). BPBD issues technical recommendations to PUPR concerning the rehabilitation of damaged public infrastructure, such as roads, bridges, and public facilities. Additionally, for damaged private assets such as residential houses, BPBD coordinates with PERKIMTAN LH to initiate phased reconstruction and recovery efforts.

This collaborative process demonstrates the effective synergy among local government institutions in supporting comprehensive post-disaster recovery. Strong coordination ensures that rehabilitation and reconstruction initiatives address not only physical infrastructure but also fulfill the basic needs of affected communities in an efficient and targeted manner.

Weakness

Theme: Limited Budget Allocation for Post-Disaster Rehabilitation and Reconstruction Activities

Post-disaster rehabilitation and reconstruction efforts in Sawahlunto City have not been optimally implemented across all affected areas. One of the main challenges lies in the limited budget allocated for these activities. The constrained funding results in a focus on restoring only the most severely damaged infrastructure, particularly those deemed urgent.

However, the emphasis on temporary solutions—such as constructing makeshift retaining walls (beronjong) using minimal materials—has limited long-term effectiveness. These measures are only suitable in the short term and fall short in reducing future disaster risk. This situation reflects that the planning and execution of rehabilitation and reconstruction activities have yet to fully integrate sustainable disaster risk reduction principles, thereby hindering long-term resilience in disaster management.

Opportunity

Theme: Funding Support for Rehabilitation and Reconstruction from BNPB

One of the opportunities that can be utilized to optimize disaster management efforts is the availability of grant funding from the National Disaster Management Agency (BNPB). This funding is allocated for the repair and reconstruction of damaged infrastructure and public facilities following a disaster.

As part of its efforts in the rehabilitation and reconstruction phase, the Regional Disaster Management Agency (BPBD) of Sawahlunto City, through the Jitu Pasna team, submitted a funding proposal to BNPB. The proposal outlined an assessment of the disaster's impacts, identified the rehabilitation needs, and presented a detailed reconstruction plan. In total, BPBD proposed 11 priority locations that required post-disaster recovery interventions.

BNPB, through its rehabilitation and reconstruction division, followed up on the proposal by conducting a review process, including a reassessment and field survey of the proposed locations. Based on the results of these evaluations, only five out of the eleven proposed

activities were approved for further implementation. After the planning documents were validated, BNPB and BPBD reached an agreement to commence the physical implementation of the five approved activities in 2025. The implementation is scheduled to take place over two fiscal years.

Theme: Utilization of Pokir Fund Assistance

The Village Government of Sawahlunto City has submitted a request for financial assistance to repair infrastructure damaged by disasters using Pokir (Aspiration Fund) allocated by council members. These funds can be accessed if the village government submits a proposal to the council members requesting financial support for infrastructure projects. The utilization of Pokir funds can help finance infrastructure repairs affected by disasters while also strengthening political support for landslide disaster management programs in Sawahlunto City.

Threats

The threats obtained are aimed at all disaster management activities which have been summarized in three main threats including:

Theme: High-Intensity Rainfall with Long Duration

One of the external threats causing landslides in Sawahlunto City is extreme rainfall. The city frequently experiences high to very high rainfall intensity, which is often followed by landslides, both during and after the rain. In areas with relatively steep slopes and a significant amount of overburden soil, heavy rainfall increases pore water pressure, reduces effective stress, and, combined with the supporting topographic conditions, makes these areas highly susceptible to landslides.

Theme: Topographic and Geological Threats to Landslides

Sawahlunto City is highly susceptible to landslides due to its topographic and geological conditions. According to one of the interviewed sources, the city has unique geological characteristics as a sedimentary area. Historically, the land in this region underwent an uplift process from the bottom up, which is evident from the distinctive layers in the soil structure. The sedimentation in this area is predominantly composed of clay-rich soil, which is highly susceptible to weathering. As the soil undergoes weathering, its strength significantly decreases, thereby increasing the risk of landslides. Additionally, the topography of Sawahlunto City, which is dominated by hilly terrain, further elevates the landslide risk. The steeper and higher the slope of an area, the greater the likelihood of soil movement and sliding, particularly when combined with weak sedimentary soil conditions. The combination of weathered sedimentary soil and steep topography makes Sawahlunto City highly vulnerable to landslides.

Alternative Strategies to Reduce Landslide Risk in Sawahlunto City

Pre Disaster Activities

Disaster Mitigation

Weakness - Opportunities Strategy: Enhancing Synergy Between BPBD, DPR Members, and the Village Government

Optimizing the Pokir fund to address financial limitations in implementing structural mitigation activities. This can be achieved by establishing intensive coordination between the Village Government, BPBD, DPR members, and the PUPR Department to discuss mitigation-based infrastructure development, with funding sourced from the Pokir allocations of DPR

members. The Village Government will submit a proposal detailing the required mitigation-based infrastructure development to the Sawahlunto City DPR. Before submission, the proposal will first be reviewed by BPBD, and the proposed work will then be forwarded to the PUPR Department for further action.

Weakness - Opportunities Strategy: Optimizing Community Participation in Community-Based Mitigation Development

This strategy involves engaging the village community through a mutual cooperation program in developing mitigation infrastructure, such as constructing simple drainage systems or reinforcing slopes. The approach utilizes a straightforward yet effective construction design, such as slope retaining structures (revetments) or gabions made from locally available materials. Additionally, simple drainage system repairs are carried out under the supervision of the Village Government, BPBD, and the PUPR Disaster Response Team.

Weakness - Threats Strategy: Strengthening Regulations on Building Permits in Landslide-Prone Zones.

The strategy to strengthen this regulation is to update the disaster risk map with detailed information on landslide-prone zones. Additionally, the BPBD website of Sawahlunto City should be updated to include the latest disaster data, accurate information on vulnerable areas, and a complaint channel for reporting spatial planning violations. Disaster information boards should also be installed at village or sub-district offices. Furthermore, the PUPR Department, in collaboration with relevant agencies, must revise building permit regulations by introducing a risk assessment template to facilitate the completion of permit documents for both the community and the private sector. To ensure that building permits comply with existing regulations, it is recommended that the PUPR Department and BPBD establish a monitoring team.

Weakness – Threats Strategy: Developing an Appropiate Contingency Plan for Sawahlunto City

BPBD Sawahlunto City must develop a contingency plan that outlines disaster scenarios based on the type and intensity of landslides, along with their associated risk levels. The plan should include emergency response protocols, a clear division of roles and responsibilities among relevant stakeholders during emergencies, and an inventory of available resources and capacities, including personnel, equipment, and budget. The document should be tailored to the topographic and geological conditions of Sawahlunto City. Additionally, it must be regularly updated to remain relevant to current conditions.

Weakness – Threats: Validating the Landslide Disaster Management Plan (RPB) as A Regional Regulation in 2025

One of the strategic efforts to reduce disaster risk in Sawahlunto City is to formalize the Landslide Disaster Management Plan (RPB) as a Regional Regulation (Perda) in 2025. This process can be initiated through coordination meetings involving key stakeholders such as the Regional Disaster Management Agency (BPBD), the Sawahlunto City Government, the Sawahlunto City Parliament (DPRD), the Regional Development Planning Agency (Bappeda), the Head of Spatial Planning from the Public Works and Spatial Planning Office (PUPR), and representatives from both village and sub-district governments. The local government is expected to draft a Mayor Regulation to outline the technical steps of implementation, including budget allocation, institutional responsibilities, and oversight mechanisms. The

drafting process will refer to the existing Landslide Hazard Zone (KRB) data as the principal technical basis for formulating the RPB content.

A similar approach has been implemented in Banten Province, where the Disaster Management Plan (RPB) for the 2023–2027 period is being legalized through a Regional Head Regulation. This demonstrates the province's commitment to strengthening legal frameworks that support disaster risk reduction and ensure the formal adoption of the RPB as a strategic reference for program planning and implementation. The document is also harmonized with regional development plans, including the Medium-Term Regional Development Plan (RPJMD), ensuring intersectoral coherence and policy alignment [16].
The legalization of the RPB in Sawahlunto is anticipated to offer similar benefits, such as legal certainty, enhanced inter-agency coordination, and the institutional integration of disaster risk reduction into local development policies.

Strength - Opportunities Strategy: Expanding Disaster Awareness and Socialization Efforts Across All Villages and Sub-Districts in Sawahlunto City
BPBD of Sawahlunto City can establish a Disaster Awareness Team consisting of Tagana, KSB, and Linmas. This team will receive intensive training in disaster management, disaster education, and counseling methods. BPBD, in collaboration with the Disaster Awareness Team, will develop a structured plan for disaster awareness campaigns and socialization efforts across all villages and sub-districts. The primary focus of this team will be to enhance community capacity in disaster preparedness and response.

Strength – Opportunities Strategy: Strengthening the Sitaruna Darling Innovation Through the Optimization of the Mutual Cooperation Culture
The BPBD of Sawahlunto City, in collaboration with the Village Government, can schedule Sitaruna Darling activities in each village, involving KSB as part of the Disaster Awareness Team and the Village Government as the main driving force behind community participation. Additionally, KSB will guide the village community in maintaining a clean environment, ensuring proper drainage flow, managing waste, and planting trees to improve environmental sustainability.

Strength - Threats Strategy: Optimizing Disaster Signs and Posters as a Mitigation Effort Against Geological and Topographical Vulnerabilities in Sawahlunto City
BPBD can enhance the installation of disaster signs and posters in strategic locations at risk of landslides. To maximize their effectiveness, the information on these signs should not only serve as passive warnings but also provide clear guidance on evacuation routes. Additionally, BPBD can include emergency contact information or QR codes linked to real-time threat data.

Preparedness Activities
Strength – Opportunities Strategy: Establishment and Strengthening of Community-Based Forums
Integrating educational and training activities systematically and equitably across elementary and junior high schools in Sawahlunto City. These activities include conducting disaster management simulations, basic disaster training, and regular discussions on landslide mitigation while actively involving school communities. Building on the counseling program, the Disaster Awareness Team will schedule the independent formation of Destana by utilizing available funds from the Village Government in a fair and distributed manner.

Weakness – Opportunities Strategy: Recalibration and Repair of the Early Warning System

BPBD can recalibrate and repair damaged early warning systems to restore their optimal functionality. This can be achieved by adding security features to enhance the system's durability, such as protection against extreme weather conditions or potential sabotage. To ensure the system remains operational in the long term, BPBD can involve local technicians for regular maintenance. Additionally, BPBD can leverage technology by developing applications or online portals that provide real-time data on landslide-prone zones, land movement maps, and early warning points.

Emergency Disaster Response Activities

Weakness – Opportunities Strategy: Enhancing Collaboration with the Private Sector (Mining Companies)

BPBD Sawahlunto City can establish a formal agreement with mining companies to strengthen collaboration with the private sector. This can be achieved by drafting a cooperation agreement that outlines the readiness and procedures for borrowing heavy equipment. Additionally, an emergency protocol should be developed to regulate the borrowing mechanism, including communication procedures, responsibilities, and response times. Furthermore, improving coordination between BPBD and relevant agencies—such as the PUPR Office, Health Office, Social Office, and Tagana—can enhance the overall effectiveness of disaster response efforts.

Post - Disaster Activities

Weakness – Opportunities Strategy: Maximizing Financial Assistance from BNPB to Support Comprehensive Rehabilitation and Reconstruction Efforts

The BPBD Tim Jitu Pasna, in collaboration with the disaster response team from the PUPR Office, compiles comprehensive damage assessments covering all categories of infrastructure damage. This process involves coordination through meetings and the preparation of activity planning recommendation proposals. BPBD can submit detailed priority recommendations for reconstruction efforts to BNPB based on identified development need.

CONCLUSION

This study evaluates landslide disaster management in Sawahlunto City by integrating thematic analysis and SWOT analysis. The findings reveal that key strengths lie in community participation through locally based disaster forums, a strong tradition of mutual cooperation (gotong royong), and effective inter-agency collaboration during the emergency response phase. However, the overall implementation remains limited due to constraints in personnel, equipment, regulatory enforcement, and funding—particularly during the rehabilitation and reconstruction phase.Scientifically, this research contributes to the understanding of locally grounded disaster management by mapping the interaction between institutional capacity, community response, and structural challenges in hazard-prone areas. The results enrich the disaster management literature in Indonesia, especially in resource-constrained regions with strong social capital.

From a policy perspective, there is an urgent need to strengthen local regulations, institutional capacity, and the integration of contingency plans into formal regional policies. Local governments should also ensure more sustainable budget allocations, increase the role of the private sector—particularly mining companies—in providing heavy equipment during emergencies, and optimize the use of village funds (APBDesa) and rehabilitation grants from BNPB.

By fostering cross-sectoral synergy and enhancing community-based capacity, disaster management strategies in Sawahlunto can evolve into a more adaptive, inclusive, and sustainable system. These findings are expected to serve as both a scientific reference and a strategic guide for policymakers in other disaster-prone regions with similar characteristics.

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