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Post-eruption economic recovery: Strengthening livelihoods in Lumajang Indonesia after Mount Semeru disaster

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ABSTRACT

Natural disasters in Indonesia result in significant material and nonmaterial losses. According to the National Disaster Management Agency (BNPB), disasters in 2021 have caused 709 deaths, 73 missing persons, and displaced 583,840 people. Post-disaster recovery efforts, including economic assistance, are essential for restoring people's livelihoods. The implementation of economic assistance after the Mount Semeru eruption in the Lumajang Regency included several stages: preparation, socialization and location survey, group formation, technical guidance, provision of stimulant assistance, exit strategy planning, and monitoring and evaluation. As a result, two livestock groups were established in the Bumi Semeru Damai permanent housing area, each consisting of 10 members and legally recognized by a village decree. These groups successfully carried out daily livestock management, enhanced productivity and welfare, improved market access, and increased the understanding of livestock product marketing. The initiative fostered sustainability and independence, with the groups evolving into leading livestock centers specializing in goats in the Lumajang Regency. Critical factors supporting sustainability included a sufficient supply of animal feed that met nutritional requirements. This economic assistance program played a vital role in revitalizing the local economy by utilizing local commodities, forming community-based economic institutions, and strengthening local capacities through a disaster risk reduction approach. In addition, the program secured local government and stakeholder support, contributing to long-term recovery and alignment with sustainable regional development. This case highlights the importance of integrated economic recovery programs in post-disaster contexts for building resilience and improving community welfare.

Keywords: Post-disaster recovery, Economic assistance, Livestock groups, Community resilience, Disaster risk reduction.

1. INTRODUCTION

Indonesia is a country with high exposure to natural disasters owing to its position on the convergence of three major tectonic plates: the Indo-Australian, Eurasian, and Pacific. This geological setting frequently causes earthquakes, volcanic eruptions, and tsunamis (BNPB, 2021). In 2021 alone, natural disasters have resulted in 709 deaths, 73 missing persons, and 583,840 displaced people (BNPB, 2021). Mount Semeru, located in Lumajang Regency, East Java, erupted in December 2021, following a major eruption in 2020. The hot clouds traveled up to 11 km, severely affecting the Pronojiwo and Candipuro Districts. According to the BPBD Lumajang, the 2021 eruption caused 61 fatalities and forced 4,423 people to evacuate. More than 1,100 houses, schools, health centers, and roads have been damaged (Lumajang, 2022). In response, the local and national governments relocated affected communities to Bumi Semeru Damai (BSD), a resettlement area in Sumbermujur Village. Residents lost their main livelihoods sand mining in Supiturang and agriculture/livestock in Sumberwuluh and had to adapt to new environments with no immediate economic infrastructure. This article presents a structured recovery initiative designed by Universitas Airlangga in collaboration with the BNPB, BPBD, and related stakeholders to support community-based economic revitalization through livestock group formation and empowerment.

This was directly affected by the eruption of Mount Semeru, which occurred consecutively over the last two years. An eruption is the release of volcanic material from a volcano, such as lava, gas, ash, etc., into the Earth's atmosphere and onto the Earth's surface in erratic quantities. Volcanic eruptions occur due to the movement or activity of magma deep within the earth, trying to escape to the Earth's surface. Eruptions are of two types. First, explosive eruptions sometimes produce popping or booming sounds that are quite loud. Second, the eruption effusively created incandescent molten lava that flowed down the mountain slopes. Mount Semeru erupted, followed by hot clouds falling from their peak on December 1, 2020. The sliding distance of the hot clouds was between 2 km and 11 km. Apart from causing fatalities and injuries, these hot clouds have also caused major damages and losses in 2 (two) sub-districts: Pronojiwo Sub-district and Candipuro Sub-district, Lumajang Regency, East Java Province. A year later, on Saturday, December 4 2021 at 15.20 WIB, Mount Semeru erupted, which led to Pronojiwo District and Candipuro District. The eruption, followed by hot clouds falling from the peak, triggered many casualties. The eruption incident resulted in loss of life and property (see Figure 1).

Figure 1. Damage to Residents' Houses and Public Facilities Due to the Eruption of Mount Semeru

The calculation of estimated economic infrastructure losses and total losses considers the condition of damage to roads, markets, health and education facility buildings, markets, etc., as shown in Figure 1. Damaged infrastructure is the responsibility of the Central and Regional Governments to replace/repair. However, the social trauma that has occurred in society after the devastating 2021 eruption is a new condition that must be overcome.

Table 1. Total Impact caused Mount Semeru Eruption Disaster

Information	Amount
Fatalities	
Death (persons)	61
Refuge (persons)	4,423
Serious Injury (persons)	1
Houses and Public Facilities	
House (Unit)	1,107
Place of Worship (Unit)	19
Educational Facilities Building (Unit)	25
Health Facility Building (Unit)	3
Bridge Infrastructure (Unit)	9
Road Infrastructure (Meters)	2,000

As shown in Table 1, 61 deaths occurred, and 4,423 people were forced to flee. Furthermore, 1,107 houses, 19 places of worship, and 37 educational facilities, health facilities, and bridge infrastructure were damaged as a result of the disaster. With this amount of damage, the value of the damage (Rupiah) caused is very large.

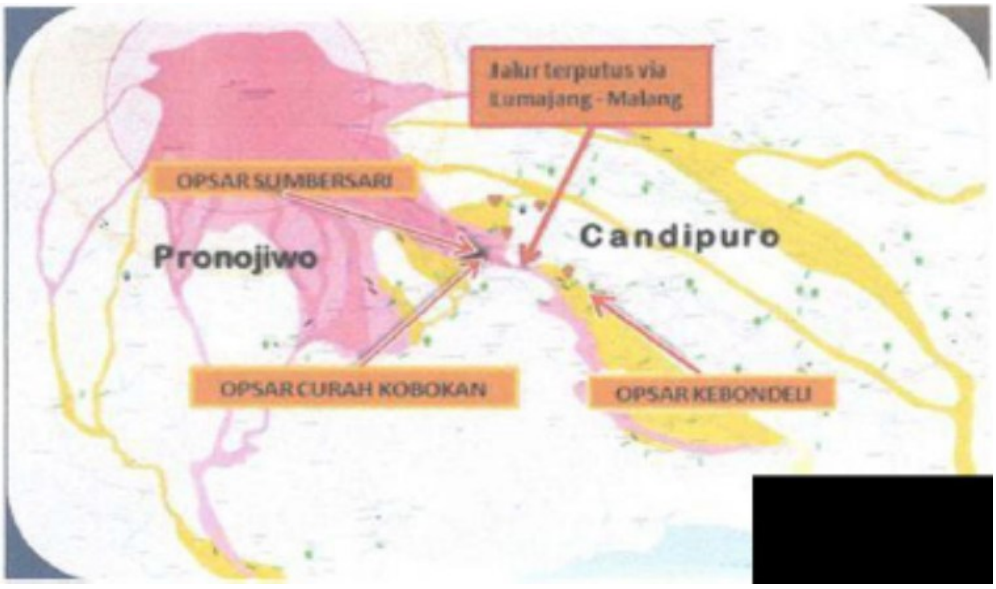

Figure 2. Map of Impact Distribution Due to the Mount Semeru Eruption Disaster

Figure 2 shows a map of the areas affected by the 2021 eruption. In the image above, it appears that the Search and Rescue Operation (OPSAR) is centered in Pronojiwo District (500-1,000 masl) as an area with a higher topography than Candipuro District (320 masl). This caused most of the Pronojiwo District area to experience more severe damage than the Candipuro District area. The largest estimated damage was in Supiturang Village (Pronojiwo) and Sumberwuluh Village (Candipuro). Expressed in damage ratios, the results of the kick-off meeting with the Regional Disaster Management Agency (BPBD) of Lumajang Regency showed that 90 percent of the affected people came from Pronojiwo District and the rest came from Candipuro District. The Mount Semeru eruption disaster caused large material and nonmaterial losses.

Table 2. The value of damage and losses due to the Mount Semeru eruption disaster in Lumajang

Damage Type	Damage Value	Estimated Loss Value	Total Damage and Loss
Housing area	203,534,100,000	30,825,019,600	234,359,119,600
Infrastructure	351,046,843,000	327,539,200,000	678,586,043,000
Economy	492,175,880,000	100,752,009,000	592,927,889,000
Social	5,664,850,000	-	5,664,850,000
Cross Sector	-	1,663,460,000	1,663,460,000
Total			**1,513,201,361,600**

Source: BPBD Kab. Lumajang (2022)

According to Table 2. The Mount Semeru eruption disaster also caused the community's economic activities to paralyze. Mount Semeru's lava flows through parts of the sand mining, agricultural, and livestock areas in Pronojiwo District, and horticultural agriculture in Candipuro District. After the 2021 eruption, the Lumajang Regency BPBD designated Supiturang Village (Pronojiwo District) and Sumberwuluh Village (Candipuro District) as disaster-prone red zones. The Regional Government through BPBD urges the public not to live in red zone areas and seek relocation as new settlements. The relocation location for people affected by the eruption disaster is Bumi Semeru Damai (BSD), which is located in Sumbermujur Village, Candipuro District, Lumajang Regency (BPBD Lumajang Regency, 2022).

The process of relocating residents affected by the disaster has implications (direct impacts) for the people of Supiturang Village in Pronojiwo District. The latest eruption resulted in people no longer being able to mine sand and stone (sirtu), as they used to do before the eruption. Likewise, the people of Sumberwuluh Village in Candipuro District were forced to leave agricultural land and livestock in their place of origin to adapt to new economic activities at their relocation place (BNPB, 2019). The two conditions above, namely the loss of mining land in Supiturang and the loss of agricultural land in Sumberwuluh, caused the community to lose its livelihood. In new residential areas or locations, the government and regional governments-built housing on 81 hectares of production forestland. Approximately 2, 000 families built new housing. These houses were built in the form of permanent and temporary residences. The front of the house is a permanent residence, and the back is a temporary residence. Permanent housing is in the form of semi-permanent buildings with brick walls, whereas temporary housing is in the form of non-permanent buildings made of plywood. The condition of relocating housing for 2,000 families affected by the eruption disaster was adequate.

The transition to work and employment opportunities in new refugee settlements is still facing obstacles. The residents of Supiturang Village, Pronojiwo District, are used to working as sand and stone miners, but there are no mining or agricultural sites in their relocation area. The same applies to the people of Sumberwuluh Village, Candipuro District, where there is no agricultural land or livestock. This causes relocating communities to need a mentoring program to adapt to the new situation (BPBD Lumajang Regency, 2022). Based on the background described above, efforts are needed to recover the economy after the Mt. Semeru eruption. The Airlangga University Economic Assistance Team, in collaboration with the National Disaster Management Agency (BNPB), assists economic recovery activities. This activity also involves community groups in the process of mentoring and determining the stimulants. Therefore, the team decided that the affected communities would act as subjects for economic assistance.

2. LITERATURE REVIEW

Post-disaster livelihood recovery plays a vital role in the restoration of dignity and long-term resilience. Several Indonesian cases, such as the recovery from the 2010 Mount Merapi eruption, highlight the effectiveness of community-based economic programs integrated with disaster risk reduction (Tiwari

& Shukla, 2022). Livelihood assistance in Merapi focuses on agriculture and livestock support, including training, seed distribution, and infrastructure repair. The Sinabung resettlement project faced challenges in terms of restoring income-generating activities. Lessons emphasize the need for bottom-up planning and coordination among stakeholders (Sutopo, 2018). Internationally, the Mount Pinatubo recovery in the Philippines demonstrates how livelihood support, especially livestock support, combined with participatory planning and local government support, led to sustainable recovery outcomes (ADB, 2000; Bankoff, 2003). Other studies affirm the role of value chain development, trust building, and local leadership in achieving resilience (Twigg, 2015). These cases underscore the importance of integrating DRR principles, addressing social dynamics, and ensuring community ownership in recovery programmes.

3. COMMUNITY SERVICE METHOD

Preparation Stage: The program began with coordination meetings and a Focus Group Discussion (FGD) held with the BPBD Lumajang, related Regional Apparatus Organizations (OPD), and community representatives. The FGD aimed to build an initial commitment and identify the strategic sectors for economic assistance. BSD was selected as the intervention site because it represented both major affected areas (Supiturang and Sumberwuluh) (see Figure 3).

Figure 3. Coordination Meeting with BPBD Lumajang Regency and Regional Apparatus Organizations

3.1. Socialization and Location Survey

A socialization session was conducted on May 17, 2023, at Sumbermujur Village Hall, followed by a location survey. Residents' concerns and aspirations were recorded to tailor the assistance programme. Stakeholder attendance included district and village heads, community leaders, and team members (see Figure 4 and 5).

Figure 4. Socialization of the Economic Assistance Program

Figure 5. Location Survey of Bumi Semeru Damai (BSD)

4. IMPLEMENTATION

Conduct an analysis of location selection and target groups based on predetermined methods. At this stage, a survey and analysis of both secondary and primary data are carried out related to the location and community group that will be the target of assistance, so that initial information can be obtained regarding the condition of the community and the economic capital available at the location of the activity, which becomes the basis for conducting an analysis of needs. and strategies to restore the economic conditions of communities in post-disaster areas. The groups that will be formed are new groups or groups that already exist but are not active. If a group is formed from an existing but inactive group, it must include new members in the group and include a statement letter stating that they are not currently receiving assistance and are willing to live in the Bumi Semeru Damai shelter and shelter.

Mentoring activities carried out include forming community groups by improving the interaction process between group members, increasing the productivity of group members, developing the group in a better and more advanced direction, improving the welfare of its members with coordination, and allowing breeders to support and help each other, discuss, learn, and work together to improve the management system. Therefore, this livestock group plays an important role in the development of breeding businesses, especially sheep. This group formation activity was carried out on June 20, 2023, at the hall of social facility 2 Bumi Semeru Damai, which was attended by representatives of the Regional Disaster Management Agency (BPBD) of Lumajang Regency, the Head of Candipuro District, the Head of Sumbermujur Village, and the Airlangga University economic assistance team (see Figure 6).

Figure 6. Group Formation Activities

4.1. Implementing Technical Guidance 1

In this activity, participants were given training that was useful in increasing participant competency, with the aim of increasing the knowledge and skills of livestock groups and preparing the group to carry out its activities in caring for and cultivating sheep.

Figure 7. Technical Guidance Activities 1

4.2. Carrying out Technical Guidance 2

In this activity, participants were given training that was useful in increasing competence in terms of managing animal feed, starting from the classification of animal feed, types of feed, nutritional content, and sheep feed requirements. The aim of the second technical guidance activity is to increase the knowledge and skills of livestock groups and prepare the group to make animal feed, which will be

elaborated using the third technical guidance, namely, direct practice on how to process animal feed (see Figure 8).

Figure 8. Technical Guidance Activities 2

4.3. Providing stimulant assistance

At this stage, stimulant assistance was provided based on the results of the needs assessment. The results of compiling this list of stimulants were jointly agreed upon by the Implementing Team, Assistance Group, Regional Government (BPBD and OPD), and BNPB, which were then stated in the Minutes of Stimulant Determination section (see Figure 9).

Figure 9. Delivery of stimulant assistance to chopper machines and mixer machines

4.4. Implementation of Technical Guidance 3

In this activity (see Figure 10), participants were given training that was useful in increasing competence in terms of managing animal feed, starting from the classification of animal feed, types of feed, nutritional content, and sheep feed requirements. The aim of the 3rd technical guidance activity was to implement the knowledge gained during technical guidance 2 and prepare the group to make animal feed in accordance with nutritional and feed hygiene standards to produce healthy and productive livestock.

Figure 10. Technical guidance activities 3

5. RESULTS OF COMMUNITY SERVICE

5.1. General Description of Community Service Locations

Sumbermujur Village has an area of 1,690 Ha, 376.50 Ha of Wet Land, 597.50 Ha of Dry Land, and 715 Ha of Other Land. (18% of the entire Candipuro District area) Sumbermujur Village is one of ten villages in Candipuro District and is located at an altitude of between 600-800 M above sea level. Sumbermujur is a village that has received approval from the Ministry of Environment and Forestry as a relocation area for residents affected by the eruption of Mount Semeru. Approximately 2,000 families live in this village, particularly in the Bumi Semeru Damai (BSD) area. Thousands of residents were relocated to the BSD because the location where they lived was designated as a red zone prone to eruptions. Most of the property owned was damaged by eruption ash. Bumi Semeru Damai (BSD) is a relocation place for people affected by the Semeru Eruption. The location is not far from the center of the disaster but has a safer radius and distance from the Semeru lava flow. The land used was a forest belonging to a local forestry company. Economic assistance after the eruption of Mount Semeru, which was carried out for six months from April to October, resulted in several activities, including the formation of two livestock groups at the Bumi Semeru Damai permanent residence, where each group consisted of 10 people consisting of chairman, deputy chairman, secretary, treasurer, and members with the following member composition.

The names of each group are the Jaya Livestock Group and the Ungguly Livestock Group, which are stated in the minutes of the implementation of the group formation and were signed by representatives of the Lumajang Regency BPBD, the Head of Candipuro District, the Head of Sumbermujur Village, and

the head of each group. With the following member composition, the Superior Livestock Group includes Nursamsi (Chairman), Lukman Hakim (Deputy Chairman), Kusnadi (Secretary), Prasetyo (Treasurer), Sulihan, M. Syukur, Sulistiono, A. Santoso, Imam, Suliyadi The Jaya Livestock Group includes Lamsino (Chairman), Faizal (Deputy Chairman), Isharianto (Secretary), Mustakim (Treasurer), Sugianto, Buasan, Sugito, Hanafi, Nurhadi, Zainal. The legality of the group is stated in the Decree of the Head of Sumber Mujur Village. Groups can implement them in daily activities to increase group productivity, and welfare increases their understanding and ability to market livestock products. Sustainability and independence of the livestock group and becoming a superior livestock group and goat livestock center in the Lumajang Regency. Sustainability and independence of livestock groups as well as the availability of animal feed according to needs and fulfilling the nutritional value of livestock.

6. DISCUSSION

Economic assistance activities require an accurate needs analysis in line with the needs of the group. This is done to describe the condition of the area before and after the disaster, determine locations, target groups, and plan interventions based on predetermined methods, namely, scoring and SWOT analysis. At this stage, surveys and analyses of primary and secondary data are carried out regarding locations, community groups, and potential local commodities that can be developed as targets for economic assistance based on the subsectors of agriculture and plantations, animal husbandry, fisheries, industry, trade, mining, tourism, and cooperatives/MSMEs. at least 1 (one) sub-sector was selected for intervention. The post-disaster rehabilitation and reconstruction process requires adequate needs analysis based on evidence in the form of damage and loss of livelihood assets, deprivation of basic rights, disruption of social and state processes, and increased risks due to reduced capacity and increased vulnerability after the disaster. Excavating the above evidence was carried out using the Post-Disaster Needs Assessment (BNPB, 2021). This method is used to study disaster consequences, impacts, and post-disaster recovery needs. Needs analysis and Post-Disaster Rehabilitation and Reconstruction Plans can help the government and stakeholders develop rehabilitation policies, programs, and activities.

The post-disaster reconstruction process is based on accurate information from parties affected by the disaster. Thus, Jitu Pasna is a systematic method for rapidly collecting, managing, and analyzing data on post-disaster impacts and community needs. It provides accurate and accountable information on damages, losses, and needs to support an effective emergency response, rehabilitation, and reconstruction planning. This approach involves multi-sectoral stakeholders and encourages active participation from local governments and affected communities. A participatory and data-based needs analysis approach can better support the preparation of rehabilitation and reconstruction plans. Needs analysis uses a comprehensive perspective of human and community needs to recover from disasters. Needs analysis identifies all aspects of human life and society, both physical and nonphysical. Needs analysis activities aim for post-disaster recovery oriented towards the restoration of complete human dignity, which is stated in the components and scope of Jitu Pasna. The Jitu Pasna study will guide parties by presenting three important components of information for post-disaster recovery: disaster impact assessment, disaster impact assessment, and post-disaster needs assessment.

7. CONCLUSIONS AND RECOMMENDATION

After the Mount Semeru eruption, the economic assistance program effectively revitalized community livelihoods in the BSD resettlement area. It facilitated the creation of economic institutions, increased productivity and income, and laid the groundwork for resilient local development aligned with the DRR principles. The first step is to promote strong partnerships among livestock groups, local cooperatives, and private market actors. These partnerships open access to better markets, improve sales, and support business growth. At the same time, developing simple and accessible livestock insurance will help farmers protect their animals and income from risks, such as diseases or natural hazards. Strengthening the supply chain is a priority. Groups will be connected to veterinary services, feed suppliers,

and product marketing channels to improve their daily operations and ensure the health and productivity of their livestock. To guide the long-term growth of the groups, an exit strategy was created using value chain and SWOT analysis. This strategy outlines 16 practical actions to be carried out gradually over a three-year period, helping groups move toward independence and sustainability. A business continuity plan will be put in place to protect the progress made. This plan will help groups to maintain operations during times of crisis or disruption. Finally, periodic evaluations and refresher training will be conducted to assess group performance, update skills, and keep members motivated and well-prepared to manage future challenges.

Ethical approval

This research did not require ethical approval.

Informed consent statement

This research did not require informed consent.

Authors' contributions

H.H. conceived the study, developed the research design, and coordinated data collection. R.P. contributed to the theoretical framework, literature review, and manuscript drafting. N.M.S. performed the data analysis, interpretation of results, and revised the manuscript critically for important intellectual content. S.P.M. provided expertise in the health economics and veterinary perspectives, contributed to the discussion, and ensured methodological rigor. A.C. assisted with statistical validation, prepared tables and figures, and contributed to editing and final formatting of the manuscript. All authors have read and approved the final version of the manuscript and agree to be accountable for all aspects of the work.

Disclosure statement

No potential conflict of interest was reported by the author(s).

Data availability statement

The data presented in this study are available on request from the corresponding author due to privacy reasons.

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