



Community Disaster Risk Reduction and Management Activities for Volcanic Eruption in Central Negros

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Authors' contributions

This work was carried out in collaboration between both authors. The authors designed the study. Author DAO performed the statistical analysis, managed the literature searches and wrote the first draft of the manuscript. Author MNM for additional literature sources and managed the analyses of the study. Both authors read and approved the final manuscript.

Article Information

DOI: 10.9734/AJESS/2022/v36i4785

Open Peer Review History:

This journal follows the Advanced Open Peer Review policy. Identity of the Reviewers, Editor(s) and additional Reviewers, peer review comments, different versions of the manuscript, comments of the editors, etc are available here: <https://www.sdiarticle5.com/review-history/94682>

Original Research Article

Received: 07/10/2022
Accepted: 13/12/2022
Published: 14/12/2022

ABSTRACT

Aims: Determine the Disaster Risk Reduction and Management (DRRM) activities for a volcanic eruption in communities within the danger zone of Mt. Kanlaon volcano in the areas of disaster prevention and mitigation and disaster preparedness as assessed by the community leaders. Moreover, it sought to solicit challenges encountered and recommendations of the community leaders in the implementation of DRRM activities for a volcanic eruption in the communities.

Study Design: Descriptive survey.

Place and Duration of Study: 25 communities within the 14-kilometer danger zone of Mt. Kanlaon volcano in Central Negros, Philippines, between August 2021 and September 2021.

Methodology: 105 community leaders of communities identified using a purposive sampling technique. Frequency, ranking, and percentage were used to identify and determine the DRRM

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activities in the areas of disaster prevention and mitigation, and preparedness. The same statistical tools were used to identify challenges encountered and the respondents' recommendations.

Results: This study revealed that the DRRM activities were practiced and communicated with the community. Most community leaders were aware and active in planning, implementing, and disseminating preparedness and mitigation measures in preparation for a possible volcanic eruption. When it comes to challenges, the absence/weak internet signal and insufficiency of funds for rescue equipment and other emergency resources were among the significant challenges identified. As to the recommendations, holding training courses to capacitate community members and allocating funds to procure rescue equipment and other emergency resources were among those identified.

Conclusion: Prevention and mitigation and disaster preparedness activities for volcanic eruptions are being practiced by the communities. However, these are not substantive because of some challenges beyond the community's capacity to provide, like weak internet connectivity and insufficient funds to finance all the necessary rescue equipment. Moreover, the recommendations gathered imply that communities value making these DRRM activities sustainable, improved, and strengthened.

Keywords: Disaster risk reduction and management; disaster prevention and mitigation; disaster preparedness; volcanic eruption; descriptive research; Negros occidental; Philippines.

1. INTRODUCTION

Disasters, whether natural or human-induced, continuously threaten countries around the world. Between 1999 and 2018, the worldwide death toll of 495,000 people and US\$ 3.54 trillion in losses were directly linked to more than 12,000 extreme weather events [1]. Furthermore, according to the United Nations Global Humanitarian Overview 2019 report, between 2014 and 2017, 870 million people from 160 countries either lost their lives and livelihoods or were displaced from their homes because of disasters caused by natural hazards [2].

Meanwhile, the Asia-Pacific region is one of the most disaster-prone areas globally, with frequent natural disasters including earthquakes, tsunamis, tropical storms, flooding, landslides, and volcanic eruptions affecting millions of people every year [3]. Regarding disaster occurrence, the number of affected people, and economic damage, Asia also ranked the highest in disaster occurrence [4]. It is also prone to disasters because it sits on the Pacific Ring of Fire which houses over 75% of the world's active and dormant volcanoes, with 452 active and dormant volcanoes, 127 of which are active [5].

With 53 volcanoes, the Philippines has the highest population exposure to volcanic eruptions [6]. The most major volcanic eruption in the Philippines in recent history was the Mount Pinatubo eruption on June 15, 1991 [5]. To strengthen the capacities of the LGUs and communities in mitigating and preparing for,

responding to, and recovering from the impacts of disasters, Republic Act 10121 of 2010 or an Act Strengthening the Philippine Disaster Risk Reduction and Management System was enacted [7]. Furthermore, the National Disaster Risk Reduction and Management Plan (NDRRMP) 2011-2028 was approved to guide sustainable development through inclusive growth while building adaptive and disaster-resilient communities [8].

The Kanlaon volcano on Negros Island is one of the most active volcanoes and the most active one in the Central Philippines [9]. Its possible eruption is considered one of the serious hazards that the province face. Because of this, the Provincial Government of Negros Occidental conducted simulation exercises to test the preparedness and response measures in a worst-case scenario should the Kanlaon erupt [10].

Several studies on volcanic eruptions were conducted: [11] on community preparedness for volcanic hazards at Mount Rainier, USA; [12] on disasters as contingent events volcanic eruptions, state advisories, and public participation in the 20th century in the Philippines, and [13,14], and [15] on Mt. Kanlaon, which were geared at understanding its behavior, composition, and volcanic activity. However, there is a dearth of studies on disaster preparedness, prevention, and mitigation activities of the communities living in the 14-kilometer danger zone of Mt. Kanlaon, hence a gap in the literature.

Thus, the study aimed to determine prevention and mitigation and disaster preparedness activities for possible volcanic activities or eruptions, including the challenges encountered and the recommendations of the community leaders. The findings will be utilized in designing a mobile-based application that will strengthen the communities' preparedness, prevention, and mitigation measures and the information and coordination efforts between and among the stakeholders involved.

2. MATERIALS AND METHODS

This quantitative research used a descriptive survey research design. The descriptive survey data was used to determine the DRRM activities for a volcanic eruption in communities within the 14 km danger zone of Mt. Kanlaon volcano in Central Negros. Community leaders determined these activities in the areas of disaster prevention and mitigation, and preparedness. Additionally, the design was used to reveal the challenges encountered and the recommendations of the community leaders regarding the DRRM activities for a volcanic eruption in their community.

The study respondents were the 105 community leaders of the said communities. The respondents were chosen through the purposive sampling technique based on their active involvement in the implementation and membership in the DRRM committee in the community.

A researcher-made checklist based on Department of Interior and Local Government (DILG)'s Operation Listo: Program on Strengthening the Capacities and Climate Disaster Resiliency was used. The instrument consists of a checklist for minimum General Action Areas for City and Municipal LGUs for disaster preparedness. The checklist was also based on the DRRM Capacity Enhancement Project conducted by the JICA Expert Team Disaster Risk Reduction and Management and the Office of Civil Defense, Republic of the Philippines [16].

Furthermore, the instrument was validated by five experts on the research topic composed of a DRRM Officer of the province, a field officer from the DILG, a local DRRM officer, an elected Sangguniang Barangay member, and one community member from the Community Disaster Risk Reduction Management (CDRRM)

committee. The Content Validity Ratio (CVR) was used to validate the instrument and was found valid with a CVR value of 1. Finally, to determine the reliability of the checklist, it was administered to 30 non-participating community leaders, then validated using Cronbach's Alpha test. It was found reliable with the following scores: 0.942 for part II, 0.965 for the challenges, and 0.981 for the recommendations.

Further, the data were treated and analyzed using frequency count, ranking, and percentage distribution.

3. RESULTS AND DISCUSSION

3.1 Disaster Risk Reduction and Management (DRRM) Activities for Volcanic Eruption in the Area of Disaster Prevention and Mitigation

Table 1 shows top 5 disaster prevention and mitigation activities for a volcanic eruption of the 21 communities within the 14 km danger zone of Mount Kanlaon volcano as assessed by its community leaders. It shows the number of community leaders (f) who answered "Yes" to the presence of the activities represented by the percentage of the total respondents.

Findings reveal that the communities are actively involved in managing and protecting the environment by monitoring and preventing illegal activities that are detrimental to the environment. It also shows that the CDRRMCs are functional in monitoring and preparedness activities. The active participation of the communities complements the efforts of the CDRRMCs as partners in promoting disaster resilience.

The result is similar to the study of [17], which states that it is essential to maintain our rich vegetation by protecting our ecosystem and our natural buffers to help mitigate possible natural hazards. On the other hand, the study by [18] noted that the active involvement of the CDRRMC in disaster mitigation measures prevented the extreme effects of disaster in their community. Meanwhile, [19] state that, considering the impact of a volcanic eruption affecting multiple scales in the community, assessing the livelihood resources needs of the community to aid their resilience is crucial. However, the result runs contrary to the study by [20], which identified that one of the challenges in maintaining the CDRRM of the purok (zone) system is the inactivity of members attending monthly meetings.

3.2 DRRM Activities for Volcanic Eruption in the Area of Disaster Preparedness

Table 2 shows the top 5 disaster preparedness activities implemented by communities within the 14 km danger zone of Mount Kanlaon volcano as assessed by its community leaders. It shows the number of community leaders (f) who answered “Yes” to the presence of the activities represented by the percentage of the total respondents.

Data show that communities within the danger zone implement preparedness measures to anticipate a possible volcanic eruption. The result implies that the community government focuses on the readiness of their constituents by having the presence of an evacuation plan, identification of evacuation centers, and the identified routes to evacuation. It also indicates that the communities consider the vulnerable sectors in disaster preparedness as they continually update the profile of the vulnerable populations (e.g., PWDs, senior citizens, children, and others). Meanwhile, the dissemination of Mt. Kanlaon contingency plans and risk assessment results complements the top 5 activities on preparedness, which implies that the government disseminates its contingency plans and risk assessment to prepare the community for a possible evacuation and worst-case scenario.

The results substantiate the studies of [21] and [22], which states that any investment in preparedness can substantially reduce future damages, danger, and risk to communities in disaster-prone areas, especially near a volcano. The study suggests that another factor that can affect the communities’ preparedness is with the engagement and involvement of vulnerable populations in disaster management [23,20] as physical and social vulnerability of the population changes significantly during an eruption when coupled with forecasting uncertainties and the rapid landscape change associated with volcanic eruptions [24]. On the other hand, the studies of [25,26], and [27] state that communicating contingency plans to the community is needed and a practical solution to reduce the risk of disaster which contributes to the community’s preparedness. Also, [28] study emphasized that contingency plans for volcanic eruptions and other disasters must be publicly accessible to inform the public about the local government’s plans; and that the adequate, concise, and timely information delivery is vital in keeping people safe from these dangers [29]. This, in turn, can

improve their awareness and preparedness for volcanic eruptions and other disasters that threaten the community.

3.3 Challenges encountered by the Community Leaders in the Implementation of (DRRM) Activities for Volcanic Eruption in the Area of Disaster Prevention and Mitigation

Table 3 shows the top 4 challenges encountered by the community leaders in implementing DRRM activities for a volcanic eruption in the area of disaster prevention and mitigation. It shows the number of community leaders (f) who answered “Yes” to the presence of the activities represented by the percentage of the total respondents.

The findings indicate that funding allocation, infrastructure, and capacity-building issues are among the significant hindrances. Funds to local and national initiatives are inadequate. The absence or weak internet signal was identified as the top challenge, which implies that they value timely information dissemination and acknowledge the role of technology, especially the internet, in disaster management. Moreover, limited access to science, technology, and expertise in conducting DRRM activities was given emphasis as shown in the results. This result further implies that disaster management can be affected by factors that limit their ability and capacity to help the community. Lastly, the challenge of weak enforcement of policies and zoning regulations in the communities would imply lack of knowledge and proper orientation of the said policies to the community leaders.

The study of [30] affirms the importance of information dissemination is a crucial asset and instrumental in keeping people safe from imminent danger and death. Most of the communities within the danger zones have internet connectivity; but there are areas with intermittent signals. However, this problem will soon be addressed since the Philippine government developed the National Broadband Plan (NBP) to accelerate the deployment of fiber optic cables and wireless technologies all over the country, particularly in far-flung or remote areas improve the overall internet speed of the country [31]. On the other hand, although the communities receive a decent share of the DRRM fund of the LGU, the result suggests that the number of activities that need to be accomplished is at risk because of other

activities being given less attention or given more budget allocation than others. This result affirms the studies of [32], and [21] that identified budgetary constraints as one of the significant challenges in DRRM implementation. On the other hand, the study of [33] agrees that poor links and insufficient cooperation between local governments needs more attention because of the possibility of sharing of resources between local governments in this situation. The results also corroborate the study of [17] that identified several challenges including: budgetary constraints, lacking access to science, technology, and expertise, and political will is lacking that may cause the weak enforcement of policies and regulations in the communities.

3.4 Challenges Encountered by the Community Leaders in the Implementation of (DRRM) Activities for Volcanic Eruption in the Area of Preparedness

Table 4 shows the top 5 challenges encountered by the community leaders in implementing DRRM activities for a volcanic eruption in disaster preparedness. It shows the number of community leaders (f) who answered “Yes” to the presence of the activities represented by the percentage of the total respondents.

The findings reveal that the top limitations involve funding allocation, skills training, and information dissemination issues, which are critical in implementing preparedness measures for a volcanic. Limited funding can limit their capacity, particularly in acquiring rescue equipment and other emergency resources like food, non-food, and medical supplies. Meanwhile, inadequate and or insufficient leadership training and disaster management seminars could affect the community decision-makers capacity and capability. It also indicates that information dissemination drives, seminars, training, and drills on disaster preparedness for a volcanic eruption are inadequate and need to be strengthened. Although communities communicate with their constituents, the result implies that the activities' presence is insufficient and needs more attention, specifically in frequency and quality. Lastly, the result implies that communities within the danger zone do not regularly conduct maintenance of EWS and ICS equipment because of its intricacy and complexity.

The study by [33] identified challenges from insufficient funding, deficiency in leadership and

management skills, poor linkages, and cooperation with other local government's [34] study has identified inappropriate training planning, which causes inappropriate and inadequate training activities. In the same way, [35] states that the lack of leadership and management skills and low literacy rate challenge community-based disaster management. On the other hand, [36] confirms that the inadequacy of information dissemination drives and like activities impedes the communities and local governments' effective disaster management. Lastly, the poor maintenance of EWS and ICS equipment result is supported by the study of [37], which states that EWS are complex systems requiring inter-relationship between various disciplines from the sciences to engineering, governance, mass media, and the community.

3.5 Recommendations of the Community Leaders in the Implementation of (DRRM) Activities for Volcanic Eruption in the Area of Disaster Prevention and Mitigation

Table 5 shows the top 4 community leaders' recommendations for implementing DRRM activities for a volcanic eruption in disaster preparedness. It shows the number of community leaders (f) who answered “Yes” to the presence of the activities represented by the percentage of the total respondents.

The result implies that community leaders recommend holding training courses to increase community members' awareness of volcanic dangers and encourage everyone to participate more in the disaster management activities of the community. Another implication suggests revisiting and communicating existing policies and strictly implementing laws, rules, and regulations. Meanwhile, the result recommended that funds be allocated to support local and national activities related to disaster risk reduction and management. As one of the main challenges for DRRM, budgetary constraints must be given due attention and find ways to address them. The result further indicates that community leaders have recommended having more technical staff to assess disaster risk and vulnerability of the community. The data suggest that most community leaders recommend adding more skilled staff in disaster management.

The result affirms the study of [34], which states that training courses will empower people to

participate more and build their trust in community-based risk reduction management. Additionally, it agrees with [36], that recommended conducting enhancement seminars and drills to increase people's awareness of the dangers in their surroundings. Meanwhile, [32] study noted that the national government should adequately fund communities' DRRM programs. On the other hand, [38] suggests that council officials must have the attitude and culture of strictly implementing the provisions of ordinances and regulations to ensure the community's resilience against any disaster. Moreover, the result is in line with the recommendation of [20] that staffing should be adequate for a community disaster management structure to function well.

3.6 Recommendations of the Community Leaders in the Implementation of (DRRM) Activities for Volcanic Eruption in the Area of Disaster Preparedness

Table 6 shows the top 4 recommendations of the community leaders in implementing DRRM activities for a volcanic eruption in the disaster preparedness area. It shows the number of community leaders (f) who answered "Yes" to the presence of the activities represented by the percentage of the total respondents.

The result shows that community leaders acknowledge the need for financial support from the national or local governments to procure rescue equipment and other emergency resources like food, non-food, and medical supplies. It further suggests that this recommendation can address the identified challenge by budgetary constraints. Meanwhile, the recommendation to increase the engagement and participation of the community in preparedness activities implies that the communities value the importance of community participation as they are their partners in disaster management. Moreover, the result of the study suggests that community leaders must prepare and check the evacuation sites and infrastructure status, ready to be used anytime. On the other hand, a need for more leadership training and seminars that can enhance the capacity and capability of decision-makers in the community is still recognized to enhance the program further.

In like manner, another implication is that the frequent conduct of information drives, seminars, training, and drills is essential to increase community awareness of volcanic disasters. Also, the regular updating and availability of hazard maps and other DRRM plans are of great importance; the result implies that the community leaders are inclined to improve and strengthen their community's relationship with other LGUs, organizations, and stakeholders to facilitate the exchange of best practices, technical support, and possible additional funding opportunities.

The recommendation of the community leaders about funding allocation is supported by the study of [32], which states that the national and local governments should ensure adequate funding for communities for their DRRM activities. The community can use this fund to procure additional supplies, equipment, and tools. Another recommendation is for the active participation of community members and stakeholders in the disaster management program in the community. This result agrees with the recommendation of the study by [39] that it is crucial to strengthen the active participation of the community and other stakeholders to facilitate a faster transfer of knowledge and good practices. The study of [33] affirms the recommendations that include: funding allocations and technical staff skills development.

On the other hand, community leaders recommend establishing and maintaining evacuation sites with complete necessities for evacuees; however, this can sometimes be challenging due to inadequate funds, according to [40]. Meanwhile, the studies of [34] and [35] support the recommendation that there should be accurate and adequate training for community-based management disaster risk management. Coupled with leadership and management skills development, mass education, literacy, and community awareness campaigns should be conducted to educate and make people aware of the vulnerabilities, hazards, and dangers of living near a volcano [36]. Lastly, the recommendation of improving and strengthening their community's relationship with other organizations and stakeholders conforms with the study of [17], which states that it is crucial to facilitate opportunities for faster knowledge transfer and good practices.

Table 1. DRRM Activities for Volcanic Eruption in the Area of Disaster Prevention and Mitigation

Indicators	Yes		Rank
	f	%	
Campaign to stop illegal activities such as kaingin, charcoal making, illegal logging, etc. are actively monitored	100	95.2	1
Active involvement of the Barangay Disaster Risk Reduction Management Committee in tackling updates on Mt. Kanlaon Volcano	99	94.3	2
Campaign on environmental management policies, programs, and activities (e.g., reforestation, research, etc.) to help mitigate the risks of volcanic eruption	99	94.3	2
Implementation of food security measures like fruit tree growing, vegetable gardening, etc.	99	94.3	2
Conduct of purok (zone) meetings to discuss preparedness measures and protocols	98	93.3	5

Table 2. DRRM activities for volcanic eruption in the area of disaster preparedness

Indicators	Yes		Rank
	f	%	
Identifies assembly points and routes for evacuation	102	97.1	1
Update profile of residents and population (e.g., Lists of PWDs, Senior Citizens, children, etc.) at risk	101	96.2	2
Prepares evacuation plans for volcanic eruptions	99	94.3	3
Identifies safe areas for evacuation centers from volcanic disasters and related risks ready to be occupied anytime	98	93.3	4
Disseminates contingency plan for a volcanic eruption to the community	97	92.4	5
Communicate risk assessment results for a volcanic eruption to the community	97	92.4	5

Table 3. Challenges Encountered by the Community Leaders in the Implementation of (DRRM) Activities for Volcanic Eruption in the Area of Disaster Prevention and Mitigation

Indicators	Yes		Rank
	f	%	
Absence/weak internet signal which affects information dissemination	58	55.2	1
Insufficient funds to support local and national activities related to disaster risk reduction and management	56	53.3	2
Limited access to science, technology, and expertise in the conduct of DRRM activities	56	53.3	2
Lack of funding and technical support from higher LGUs	43	41.0	4

Table 4. Challenges Encountered by the Community Leaders in the Implementation of (DRRM) Activities for Volcanic Eruption in the Area of Preparedness

Indicators	Yes		Rank
	f	%	
Insufficient funds for rescue equipment and other emergency resources (e.g., food, non-food, and medical supplies)	42	40.0	1
Inadequate/insufficient disaster management leadership training and seminar to enhance the capacity and capability of decision-makers	37	35.2	2
Inadequate/insufficient awareness campaigns (e.g., information drives, seminars, training, and drills) to the community	37	35.2	2
Lack of funding and technical support from higher LGUs	37	35.2	2
Maintenance of EWS and ICS equipment is poor	35	33.3	5

Table 5. Recommendation of the Community Leaders in the Implementation of (DRRM) Activities for Volcanic Eruption in the Area of Disaster Prevention and Mitigation

Indicators	Yes		Rank
	f	%	
Hold training courses to capacitate members of the community	60	57.1	1
Strict implementation of laws, rules, and regulations related to volcanic disaster prevention and mitigation activities	59	56.2	2
Allocate funds to support local and national activities related to disaster risk reduction and management	59	56.2	2
Have more technical staff to assess disaster risks and vulnerabilities of the community	56	53.3	4

Table 6. Recommendations of the Community Leaders in the Implementation of (DRRM) Activities for Volcanic Eruption in the Area of Disaster Preparedness

Indicators	Yes		Rank
	f	%	
Allocate funds to procure rescue equipment and other emergency resources (e.g., food, non-food, and medical supplies).	63	60.0	1
Increase engagement and participation of the community in preparedness activities.	62	59.0	2
Prepare and check the evacuation sites and infrastructure to always be ready and available.	61	58.1	3
Establish disaster management leadership training and seminar to enhance the capacity and capability of decision-makers.	59	56.2	4
Increase public awareness campaigns (e.g., information drives, seminars, training, and drills).	59	56.2	4
Regularly update and make publicly available hazard maps and other DRRM plans.	59	56.2	4
Provide additional funding and technical support from higher LGUs.	59	56.2	4

4. CONCLUSION

Given these results, the study revealed that prevention and mitigation and disaster preparedness activities for volcanic eruptions are being practiced by the barangays located within the 14-kilometer zone of Mt. Kanlaon volcano in Central Negros Occidental. The result means that these communities have been implementing various activities related to a volcanic eruption in the two areas of DRRM. The study affirms that people's knowledge influence what the communities must do to prevent, mitigate, and prepare for the dangers of living around Mt. Kanlaon volcano. However, these are not substantive because of some challenges beyond the barangay's capacity to provide, like weak internet connectivity and insufficient funds to finance all the necessary rescue equipment. These challenges imply that communities know the deficiencies and limitations of implementing these activities. Moreover, the recommendations gathered imply that communities value making these DRRM activities sustainable, improved, and strengthened.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

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