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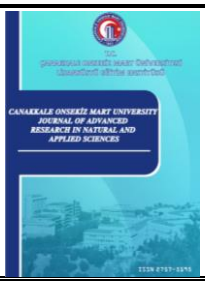

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Community-Based Strategies for Disaster Preparedness in Mauritius

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Abstract − Mauritius is Small Island Developing State (SIDS) of volcanic origin which lies in the South-West Indian Ocean Basin and is vulnerable to the consequences of global environmental challenges. The fourth priority action of the Sendai Framework for Disaster Risk Reduction 2015-2030 is to consolidate disaster preparedness for an effective response and to have a Build Back Better agenda that will improve recovery, rehabilitation, and reconstruction. This research aimed at examining the disaster management system in Mauritius through community-based approaches. The National Disaster Risk Reduction and Management Centre's (NDRRMC) involvement with the community living in high-risk zones was investigated. This study used quantitative data gathered from secondary sources and included the number of field training simulation exercises, training of volunteers under the Community Disaster Response Programme (CDRP), awareness campaigns and formulation of contingency plans based on documentation across Mauritius. The NDRRMC identified 109 high-risk zones across Mauritius out of which 13.7 per cent benefitted from all four forms of mitigation activities. Results indicated that contingency plans in Mauritius were evidence-based and had been developed after identification of disaster risk in selected regions, and therefore, they were limited to some types of disasters only. Findings also revealed that flooding was the most common type of simulated disaster exercise undertaken. The greatest number of field simulation exercises was carried out in Poste de Flacq. Results also demonstrated that only 38.5% of the community were exposed to disaster-related awareness campaigns, making it the least common form of disaster risk reduction (DRR) activity in Mauritius.

Keywords − *Community-based strategies, contingency plans, disaster preparedness, simulation exercises, Mauritius*

1. Introduction

Various approaches have been employed to reduce vulnerability and build the resilience of local communities to the impacts of climate change and disasters across the world. Small Island Developing State (SIDS), such as Mauritius, frequently experience natural hazards, namely, tropical cyclones, sea-level rise, storm surges, landslides, Indian Ocean waves (IOWaves) and flash floods. The National Risk Reduction and Management Policy 2020-2030 recognizes the importance of empowering our communities to strengthen their resilience, thus reducing significant economic and human losses in Mauritius [1].

The number of disasters and casualties which arise from natural hazards has increased around the world [2]. The World Risk Report of 2017 ranked Mauritius as the 13th country with the highest risk worldwide, and 7th on the list of countries having the greatest exposure to natural hazards [3]. According to the National Disaster Risk Reduction and Management Centre (NDRRMC), heavy/torrential rains result in flooding which accounts for more than 70 per cent of disaster events in the Republic of Mauritius. The estimated cost of infrastructural damages due to flooding will reach US $ 2 billion in the Republic of Mauritius in the next 50 years [4]. Small islands such as Mauritius are increasingly prone to socio-economic losses and environmental degradation as a

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result of their geographical remoteness, heavy reliance on international markets, limited number of resources and high coastal population densities [5].

Mauritius has made tremendous efforts to maintain an acceptable level of investment in cyclone preparedness measures and its community-based disaster response teams [6]. The organizational structure of the NDRRMC consists of a full-fledged community staff in each of the District Councils and Municipal Councils across Mauritius. It ensures that the local communities are aware of the alert system and that there are regular trainings in place for torrential rains and flash floods [6].

While there have been several attempts to include Information and Communication Technology (ICT) in the different phases of disaster management process in Mauritius [7], Ruchama and Ansaram [8] concluded that community capacity building and social networking services remain the most effective techniques for disaster risk reduction in Mauritius. Although the concept of community-led approaches has emerged internationally and has been implemented by various organizations, they remain a serious challenge in many countries [9]. Several low-income countries have also adopted a bottom-up approach to disaster risk reduction by engaging communities. In Mauritius, the study of community engagement in disaster risk reduction and various other fields is limited. Betchoo [10] assessed the importance of engaging rural communities in climate change and sustainable development and emphasized the need to involve Mauritian citizens in issues affecting them directly. Community engagement was also found to be one of the positive factors which contributed to contain the outbreak of the Covid-19 pandemic in Mauritius [11].

Previous studies carried out in other SIDS such as the Caribbean Islands have demonstrated that some sectors of the communities have limited capacity to cope with natural hazards [12-14]. Betchoo [9] further highlighted that community engagement might help to understand the hindrances to an effective coordination of disaster risk reduction activities between communities and local organizations in Mauritius. Walshe et al. [15] also conducted a disaster-related study on the Mauritian society and examined the long-term cyclone memory of communities in Mauritius. Their study revealed that long intervals between natural hazards such as large tropical cyclones, may result in populations forgetting their exposure and practices of response. As a matter of fact, several authorities are being urged to address the challenge of natural hazards impacting on human settlements with the close collaboration of the local communities [16]. As an effective community engagement can make a difference in the outcome of a crisis, its successful implementation is important in order to achieve measurable and sustainable goals in disaster risk reduction in Mauritius.

2. Relevance of Capacity Building and Community-Based Approaches in DRR

Concepts of capacity building at community level in DRR have been previously applied by various scholars [17-19]. Community-Based Approaches (CBAs) are emerging rapidly as the development community comes to understand the benefits of these approaches [20,21]. For instance, CBAs take into consideration local cultures and development issues [22] such that communities are able to readily collaborate with development partners and identify risks themselves using place-specific knowledge of their local environments [23].

The occurrence of small to moderate, recurrent, and repeated threats often required the need to tap into local knowledge and capacity for organization and action [24]. Zubir and Amirrol [25] also highlighted the need for participatory involvement of the local community as one of the many aspects of DRR. People at the community or village levels are the first to suffer the adverse effects of extreme weather events regardless of whether the disaster is of national or regional proportion. They adopt coping and survival mechanisms to face and respond to the crisis well before external help from Non-Governmental Organizations (NGOs) or the Government can

reach them. On the other hand, Mc Bean and Rodgers [18] considered capacity building as a means of identifying the limitations in governmental response and developing alternative ways to overcome these barriers. Unfortunately, the roles of communities are often undervalued and at times ignored too [26]. Shah et al. [19] assessed current capacity levels of local institutions in Pakistan and found that local institutions were poorly prepared in terms of awareness and trainings. Their study concluded that one way to reduce the vulnerability of communities was to enhance the preparedness levels of local institutions through capacity building, so that they are able to provide first-hand rescue and support to the communities.

2.1. Legislations in Mauritius

Community engagement in disaster management has been one of the objectives of Hyogo Framework for Action (HFA) 2005-2015 and its successor, the Sendai Framework for Disaster Risk Reduction (SFDRR) 2015-2030. The SFDRR is a non-binding framework which intends to fill in the gaps identified in the HFA 2005-2015 and completes the disaster cycle by including response and recovery periods [27]. In order to be in line with the targets set by the SFDRR, the National Disaster Risk Reduction and Management Act 2016 in Mauritius stipulates that each local committee shall have a close collaboration with its local community under the supervision of the NDRRMC. One of the key functional areas of the NDRRMC is to mitigate the impacts of natural hazards, to prepare for measures which will minimize harm to economies and populations, to respond during emergencies and to ensure a smooth and timely recovery of affected communities. For the period 2020-2030, the NDDRMC has also worked out a NDRRM Action Plan, a Strategic Framework and a Policy to strengthen its disaster-related legislative capabilities.

2.2. Contingency Planning for Disasters in Mauritius

A contingency is a highly uncertain situation that is likely to occur shortly but may not [28]. Local authorities, therefore, devise a contingency plan which is a set of procedures and clearly defined strategies based on uncertain events which occur at different scales to coordinate operations in times of disasters [29]. While contingency planning was initially formulated to address technological hazards such as toxic spills and industrial blasts, there has been an increasing emphasis on incorporating natural hazards, such as floods, storms, and earthquakes in contingency plans [30]. Sikka et al. [31] investigated the relevance of contingency planning for agricultural practices in India to meet the challenges of extreme weather events. Hussein [32] also examined the use of contingency planning and operational plans among the Indonesian communities and how these have been approved by the community leader and integrated into the local development planning programme. Koenti [33] also adopted a contingency approach to evaluate the disaster management system in Yogyakarta in Indonesia in partnerships with government agencies, state companies, the private sector, NGOs, international institutions, and the community. However, assessing contingency plans through real-time simulation can be costly, and, if the planned scenario does not occur, the contingency plan may not be enacted [33].

Given that a well-prepared contingency plan is essential to increase the capacity of the personnel in charge, the NDRRMC in Mauritius ensures that disaster contingency plans are prepared, reviewed, and updated periodically with the involvement of relevant institutions [4].

2.3. Field Training Exercise Simulation as an Important Aspect of DRR

There is ample literature on the use of simulations in heightening awareness in several different settings [34-36]. Lizuka [17] assessed disaster training exercises in Sri Lanka in which 6709 people living in disaster affected areas had participated. Her study revealed a positive response to the training activities. The United Nations for Disaster Risk Reduction (UNDRR) has also published a training manual which provides background information on conducting simulation exercises and drills on DRR to support the Sendai Framework for Disaster Risk Reduction (SFDRR) 2015-2030. It identified different types of simulation exercises, such as tabletop exercise and drills, that would enable professional teams such as the firefighters, medical personnel and the first- responders to test their equipment, plans, procedures, skills, and knowledge.

The NDRRMC opted for disaster simulation exercises as a means of preparing community members in village and municipal council areas for flooding, landslides, and tsunami-related coastal inundation. In an attempt to support tourist welfare, this training has been extended to hotels and tourist resorts whereby regular simulation exercises involving the staff and guests have been carried out to familiarize them with local coping strategies [6].

2.4. Awareness Campaigns

Mathbor [37] examined the benefits of making effective use of social capital such as social networks, social cohesion, social interaction, and community solidarity in attenuating the impacts of natural hazards that affect coastal regions. His study emphasized the importance of conducting round-the-year awareness activities for volunteers, whilst making use of local folk media to disseminate disaster-related messages to large numbers of people. As per the NDRRM Act 2016 Section 9, the NDRRMC coordinates and monitors all disaster risk reduction and management activities through community participation and public awareness activities in Mauritius. It carries out regular sensitization campaigns on DRR since knowledge management is a fundamental component for informed decision-making and coordinated actions in all phases of disaster management.

2.5. Community Disaster Response Programmes (CDRP)

Informal volunteering has gained widespread interest in disaster management as it stimulates spontaneous responses by individuals and voluntary groups from within and outside disaster-affected communities [38]. Their study looked into the implementation of appropriate policies, legal frameworks, and institutional arrangements for integrating informal volunteers in disaster management systems in European countries such as Germany, Italy, Belgium, Hungary, Sweden, Norway, Finland, and Estonia.

The successful implementation of a mitigation project is, to some extent, dependent on community involvement [39]. Therefore, the NDRRMC introduced the Community Disaster Response Programme (CDRP) which aimed at initiating volunteers to basic safety and rescue techniques such as fire safety, rope handling, first aid, water rescue activities, basic camp management, sand bagging and team building to respond to disasters. When emergencies occur, the trained community members would be able to act strategically to provide immediate assistance to victims, give adequate support to responding authorities and set up groups of disaster management volunteers at a disaster site before the arrival of government aid. One of the objectives of the NDRRMC was to develop a culture of DRR within the population and build the capacity of the community to respond to disasters, in order to be in line with the Sendai Framework for Disaster Risk Reduction (SFDRR) 2015-2030.

2.6. Purpose of Study

The research objectives of this study are to:

- examine the various CBAs to disaster risk mitigation which have been implemented in Mauritius;
- analyze the spatial distribution of contingency plans and simulation exercises in Mauritius;
- identify the type of simulation exercise with the greatest geographical extent in Mauritius;
- identify the least and most common forms of community-based disaster related activity carried out in Mauritius.

3. Methodology

3.1. Justification of Methods

The term ‘‘local participation’’ became popular in disaster discourse following the mid-term evaluation of the International Decade for Natural Disaster Reduction (IDNDR) in May 1994 such that risk reduction programmes have increasingly been engaging local residents [40]. Shaw [41] also examined the success and shortcomings of CBAs in disaster management in several countries. His analysis of CBAs varied from capacity-building, legislations, stakeholder participation and community involvement, local knowledge, and effective social networking. A series of community-based DRR methods have also contributed to improve community resilience in the landslide-prone area of Wanzhou in China [42]. Therefore, this study also attempts to investigate the different CBAs that have been implemented in Mauritius and the geographical extent to which they have been carried out throughout the country.

3.2. Datasets

This study used five datasets obtained on request from secondary sources, namely governmental organizations. Four datasets pertaining to the frequency of DRR activities such as (i) field training exercises, (ii) awareness campaigns, (iii) training exercises delivered to volunteers under the Community Disaster Response Programme (CDRP) and (iv) the availability of contingency plans, were obtained from the NDRRMC. The NDRRMC identified regions which were considered as high-risk based on place-specific evidence to prioritize training and DRR activities. The fifth dataset was made available upon request from the Statistics Office Mauritius. This dataset consisted of administrative boundaries in Mauritius which included five Municipal Council Areas (MCAs) and four District Council Areas (DCAs). These were further broken down into smaller areas known as Municipal Council Wards (MCWs) for urban regions and Village Council Areas (VCAs) for rural settlements respectively. The number of yearly DRR activities carried out in each MCA/DCA was reported to the NDRRMC by the local disaster Management Coordinator who acts as the liaison officer between the MCA/DCA and the NDRRMC. Results have been displayed for 144 administrative regions, including 124 VCAs and 20 MCWs.

3.3. Methods

3.3.1. Statistical Analysis

The NDRRMC identified 109 high-risk zones across Mauritius. The percentage of regions which benefitted from the different forms of disaster mitigation activities in the high-risk areas has been calculated using a basic statistical technique.

3.3.2. Tabulation Method

The forms of disaster mitigation activities have been summarized and displayed using the tabulation method to facilitate further analysis. Results of statistical analysis have been expressed as percentages and displayed in the form of a table for ease of comparison.

3.3.3. Mapping of Results using the Geographic Information System (GIS)

The GIS analytic tool was used to show the spatial distribution of contingency plans and simulation exercises on a thematic map which portrays the urban and rural administrative regions in Mauritius. Simulation exercises have been carried out for flooding, flash floods, torrential rain, landslides, IO Wave and tsunami. A region may have benefited from a single type of simulation exercise or a combination of exercises. Each single type or combination of simulation exercises was attributed a color while the availability of a contingency plan for a specific region was denoted by a red star on the map of Mauritius. Administrative regions which have not benefited from any simulation exercise have been grouped into the 'none' category with a white color code. However, some of these regions may have a readily available contingency plan.

4. Results

The forms of Community-Based DRR activities were divided into four capacity- building components for each region and are presented in Table 1 below: availability of a contingency plan, community exposure to simulation exercises, awareness campaigns and disaster-related volunteering programmes (CDRP). The type of simulation exercise (if any) is also shown in Table 1.

Table 1. Forms of Community-Based DRR activities carried out by region in high-risk zones

District Council Area	SN	Name of Region	Capacity Building Components				
			CDRP as at Dec 2020	Contingency Plan available as at Dec 2020	Awareness Campaigns	Simulation Exercise	Type of Simulation Exercise
Rivière du Rempart District Council	1.	Cottage	✓	✓	×	✓	Flooding
	2.	L'Amitié	✓	✓	×	✓	Flooding
	3.	Gokoola	✓	✓	×	×	
	4.	Grand Baie	×	×	×	✓	IOWave, tsunami
	5.	Péreybère	×	×	×	✓	Flooding
	6.	Amaury	×	×	✓	×	
Savanne District Council	1..	Rivière du	✓	✓	×	✓	Flooding
	2.	Bel Ombre	✓	✓	✓	✓	Tsunami, IOWave
	3.	Rivière des	✓	✓	×	✓	Tsunami, IOWave
	4.	Surinam	×	✓	×	×	
	5.	Souillac	✓	✓	✓	✓	Landslide
	6.	Britannia	✓	✓	×	×	
	7.	Grand Bois	×	✓	×	×	
	8.	Bois Chéri	×	✓	×	×	
	9.	L'Escalier	✓	✓	×	×	
	10.	La Flora	✓	✓	×	✓	Flooding
	11.	Riv. des	×	×	×	✓	Landslide
	12.	Riambel	×	×	×	✓	Tsunami/IOWave
	13.	St-Martin	×	×	×	✓	Tsunami/IOWave
	14.	Baie du Cap	×	×	×	✓	Tsunami/IOWave

Table 1. (Continued)

District Council Area	SN	Name of Region	Capacity Building Components				
			CDRP as at Dec 2020	Contingency Plan available as at Dec 2020	Awareness Campaigns	Simulation Exercise	Type of Simulation Exercise
Black River District Council	1.	La Gaulette	×	✓	✓	×	
	2.	Richelieu	✓	✓	✓	✓	Flooding, tsunami
	3.	Canal Dayot	✓	✓	×	✓	Flooding
	4.	Sable Noir	×	✓	×	×	
	5.	Bain des Dames	✓	✓	✓	×	
	6.	Pointe aux Sables	✓	✓	✓	✓	Flooding
	7.	Bambous	✓	✓	✓	✓	Flash flood, flooding
	8.	Cotteau Raffin	✓	✓	✓	×	
	9.	Albion	✓	×	×	✓	Torrential Rain
	10.	Tamarin	×	×	×	✓	Tsunami
	11.	Flic-en-Flac	×	×	×	✓	Flooding, Torrential rain
	12	Chamarel	×	×	×	✓	Landslide, Tsunami, IOWave
	13.	Petite Rivière Noire	×	×	×	✓	Tsunami
	14.	Grande Rivière Noire	×	×	×	✓	Torrential rainfall
	15.	Le Morne	×	×	×	✓	Tsunami
	16.	Cascavelle	×	×	×	✓	Flash flood
Moka District Council	1.	Morc. Sans Souci	×	✓	×	✓	Flooding
	2.	Montagne Blanche	✓	✓	✓	✓	Flooding
	3.	L'Espérance	✓	✓	×	✓	Flooding
	4.	Quartier Militaire	×	✓	×	×	
	5.	La Laura	×	×	×	✓	Flooding
	6	Moka	×	×	×	✓	Landslide
Pamplemousses District Council	1.	Fond du Sac	✓	✓	×	✓	Flooding
	2.	Cité Roma/Le Hochet	✓	✓	✓	×	
	3.	Terre Rouge	✓	✓	✓	✓	Flooding
	4.	Cité Mandela	×	✓	✓	×	
	5.	C. La Boue/B. Source	✓	✓	✓	×	
	6.	Bois Rouge	✓	✓	✓	×	
	7.	Mapou	×	×	×	✓	Torrential rain
	8.	Crève France	×	×	×	✓	Torrential rain, Landslide
	9.	Pointe aux Piments	×	×	×	✓	Tsunami/IOWave
	10.	Trou aux Biches	×	×	×	✓	IOWave/Tsunami
	11.	Abercrombie	×	×	✓	×	
	12.	Notre Dame	×	×	✓	×	
	13.	Triolet	×	×	✓	×	
	14.	Roche Bois	×	×	✓	×	
Grand Port District Council	1.	Nouvelle France	✓	✓	✓	✓	Flooding
	2.	16ème Mille	✓	✓	✓	×	
	3.	Carreau Esnouf	✓	✓	✓	✓	Flooding
	4.	New Grove/Gros Billot	✓	✓	✓	✓	Flooding
	5.	Mare Tabac	✓	✓	✓	×	
	6.	Plaine Magnien	✓	✓	✓	×	
	7.	Trois Boutiques	✓	✓	✓	✓	Flooding
	8.	B. des Amourettes	×	×	×	✓	IOWave
	9.	Rivière des Créoles	×	×	×	✓	Flooding
	10.	Vieux Grand Port	✓	×	✓	✓	Flooding
Flacq District Council	1.	Clémencia	✓	✓	×	×	
	2.	Bramsthan	✓	✓	×	×	
	3.	Argy	×	✓	×	✓	Flashflood
	4.	Cité Débarcadère	×	✓	×	×	
	5.	Poste de Flacq	✓	✓	×	✓	Flooding, Tsunami
	6.	Grand Sable	✓	✓	×	×	
	7.	Belle Mare	×	×	×	✓	
	8.	Quatre-Soeurs	×	×	×	✓	Landslide
	9.	G.R.S.E	×	×	×	✓	Tsunami
	10.	Centre de Flacq	×	×	×	✓	Torrential rain
	11.	Bel Air	×	×	×	✓	Flash flood

Table 1. (Continued)

District Council Area	SN	Name of Region	Capacity Building Components				
			CDRP as at Dec 2020	Contingency Plan available as at Dec 2020	Awareness Campaigns	Simulation Exercise	Type of Simulation Exercise
Curepipe Municipal Council	1.	Labrasserie	×	×	×	✓	Flooding
	2.	La Colombe	×	✓	✓	×	
	3.	Camp Bombaye	×	✓	✓	×	
	4.	Forest-Side	✓	✓	×	×	
	5.	Floréal/Mangalkan	✓	✓	✓	✓	
	6.	Eau-Coulée	✓	✓	✓	✓	Flooding
	7.	Les Casernes	✓	✓	✓	×	
	8.	Curepipe Centre	×	×	×	✓	Flooding
Beau-Bassin/Rose-Hill Municipal Council	1.	Stanley	✓	✓	✓	×	
	2.	Mont Roches	✓	✓	✓	✓	Flooding
	3.	Barkly	✓	✓	✓	×	
	4.	Chebel	✓	✓	✓	×	
	5.	Coromandel	✓	✓	✓	✓	Flooding
	6.	Morc. Hermitage	×	×	×	✓	Landslide
Municipal Council of Port-Louis	1.	Résidence La Cure	✓	✓	✓	✓	Flooding
	2.	Ste Croix	✓	✓	✓	×	
	3.	Le Cornu	×	✓	✓	×	
	4.	V.des Prêtres	✓	×	✓	×	
	5.	Chitrakoot	×	×	×	✓	Landslide
	6.	Tranquebar	×	✓	✓	×	
Municipal Council of Quatre Bornes	1.	Candos	×	✓	×	✓	Landslide
	2.	La Louise	×	✓	×	✓	Flooding
	3.	Bassin	×	✓	×	✓	Flooding
	4.	Avenue Berthaud	×	✓	×	×	
	5.	Ollier	×	×	×	✓	Flooding
Municipal Council of Vacoas/Phoenix	1.	Malakoff/La Marie	✓	✓	×	✓	Flooding
	2.	La Caverne	✓	✓	×	✓	Flooding
	3.	Prom. Père Laval	×	✓	×	✓	Flooding
	4.	Henrietta	✓	✓	×	✓	Flooding
	5.	Camp Belin	×	✓	×	✓	Flooding
	6.	St-Paul	×	×	×	✓	Flooding
	7.	Morc. Réunion	×	×	×	✓	Landslide
			51/109	68/109	42/109	70/109	

Table 2. Percentage of regions exposed to each capacity building component

Community-based disaster strategy	Capacity Building Component			
	CDRP	Availability of Contingency Plan	Awareness Campaigns	Simulation Exercise
% of high-risk areas exposed to DRR activity	46.8%	62.3%	38.5%	64.2%

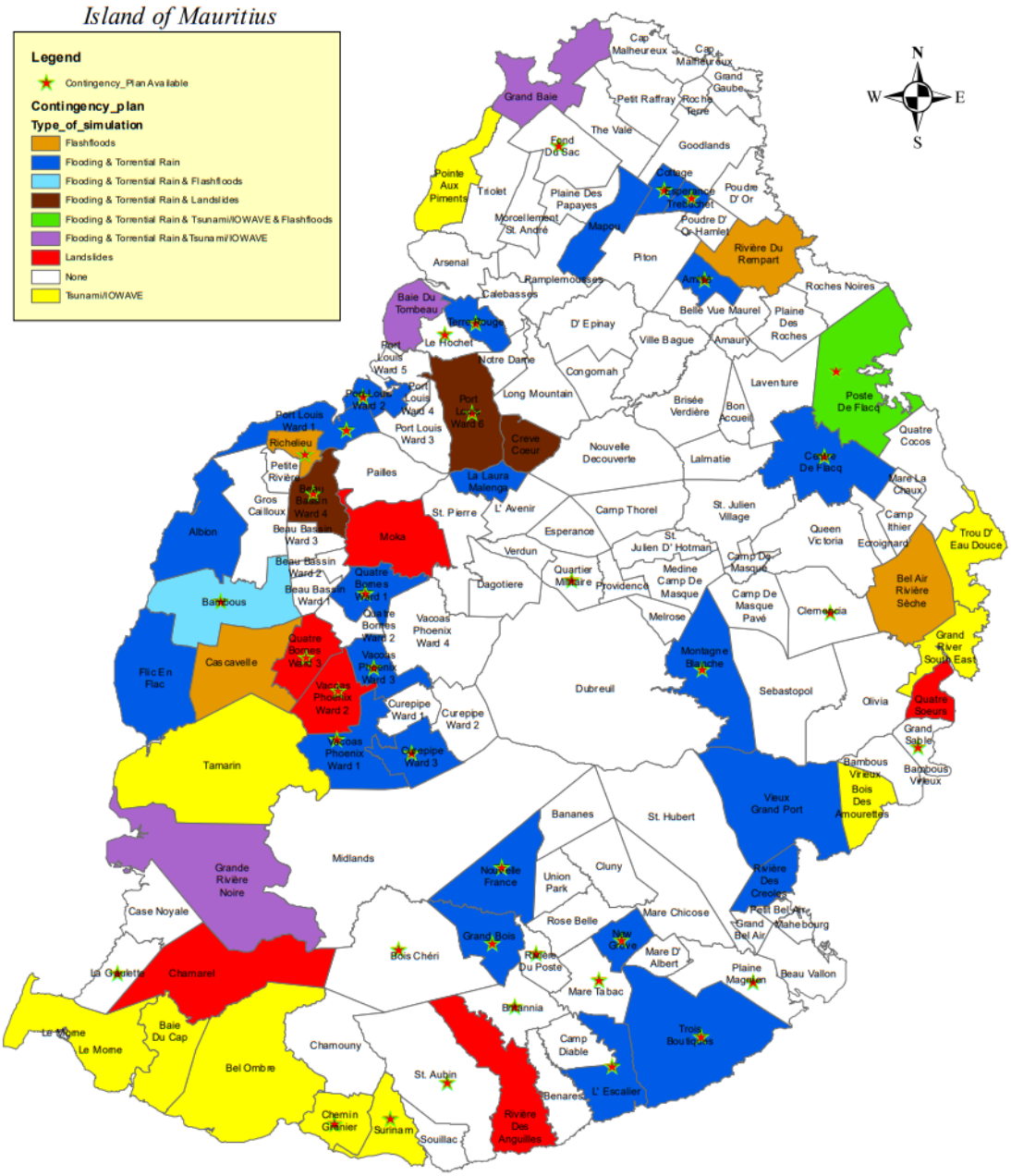

Figure 1. Spatial distribution of contingency plans and simulation exercises carried out in Mauritius as of 2020

Results showed that specific forms of community-based DRR exercises have been carried out in selected regions which have been previously identified as high-risk areas by the NDRRMC based on place-based evidence gathered from past disasters. Coastal regions have been more exposed to community-based-DRR exercises than inland regions (Figure 1). Simulation exercises have been the most frequent (64.2%) (Table 2) form of mitigation activity and flooding has been the most common simulated disaster (Figure 1).

Tsunami and IOWave simulation exercises have been carried out mostly on the South West coast, the East coast, in Tamarin on the West coast, in Baie du Tombeau and Grand Baie along the North West coast and Poste de Flacq along the North-East coast (Table 1 and Figure 1). Communities of Morcellement Réunion, Rivière des Anguilles, Quatre Sœurs, La Laura and Chamarel have benefitted from landslide-related simulation exercises. Four regions, namely Rivière du Rempart, Bel-Air Rivière Sèche, Cascavelle and Richelieu, have been exposed to simulation exercises geared towards flash floods. The greatest number of simulation exercises took place in Poste de Flacq where communities were involved in tsunami, IOWave, torrential rain and flash

floods exercises (Table 1 and Figure 1). All four forms of capacity building activities have been successfully implemented in 15 regions out of 109, but none of which was found in the Municipal Council of Vacoas/Phoenix (Table 1). The beneficiaries were Bel Ombre, Richelieu, Pointe aux sables, Bambous, Montagne Blanche, Terre rouge, Nouvelle France, Carreau Esnouf, New Grove/Gros Billot, Trois Boutiques, Floréal/Mangalkan, Eau Coulée, Mont Roches, Coromandel, and Résidence La Cure. Communities living in the mountain valleys of Port-Louis, for instance in the municipal ward 6 and in Crève Coeur, and along part of the steep-sided gorges of the Grand River North West, have been exposed to both hazardous flash flooding and landslide simulation exercises (Figure 1).

Results indicated that 62.3% of the risk-prone areas had a contingency plan ready (Table 2). In Mauritius, contingency plans are evidence-based and are limited to only some types of natural hazards. This is because contingency plans have been developed after identification of hazard risk in selected regions.

In addition, findings demonstrated that 46.8% (Table 2) of the population living in risk-prone areas have been trained under the CDRP programme in Mauritius whilst awareness campaigns remained the least common form of DRR activity (38.5%) (Table 2) carried out so far (Table 2).

5. Discussion of Findings

This study revealed that simulation exercises were the most frequent form of mitigation activity (64.2%) (Table 2) and flooding was the most common type of simulated disaster. Simulation exercises provide realistic learning situations at manageable costs [43]. Regular evaluation of the simulation exercises is required to provide evidence-based feedback on performance of all participants and to determine whether the current level of preparedness is of a satisfactory standard [44]. In another study, Gundran et al. [34] demonstrated that simulation exercises successfully enabled participants to increase their knowledge and overcome challenges in communication strategies, and to adopt these lessons to their own organizations to increase their capacity during disaster response.

Furthermore, findings indicated that 62.3% of the risk-prone areas had a readily available contingency plan (Table 2). Alexander [30] stated that contingency planning is an exploratory process which provides generic procedures for managing unforeseen impacts. According to his study, carefully constructed scenarios can help to anticipate the needs that will arise when foreseeable hazards happen. His study also emphasized the need for such plans to respond to the impacts of natural hazards, to maintain business continuity and to guide recovery and reconstruction effectively.

In addition, results demonstrated that 46.8% (Table 2) of the population living in risk-prone areas have been trained under the CDRP programme in Mauritius. Community infrastructure is essential in the post-disaster phase as shelters and an adequate number of volunteers must be provided to give assistance to the displaced households [6]. In other countries such as Sweden and Norway, community volunteering has become regulated, and volunteers are formally insured. Disaster management authorities have made extensive use of social media to register informal volunteers and to guide them through practical training exercises that focus primarily on first aid [38]. Community members who found their lives or livelihoods highly exposed to the impacts of natural hazards were more likely to actively engage themselves in disaster preparedness than those who did not [45].

In Mauritius, awareness campaigns were the least common form of DRR activity (38.5%) (Table 2) carried out so far (Table 2). Education remains one of the main priorities of the Global DRR initiatives [46,47] and raising awareness plays a key role in addressing the intricacy of adapting to climate change. Chen et al. [48]

pointed out that the traditional forms of community capacity building efforts in DRR would include access to education, training, funding, information, equipment, and food supplies, but highlighted the need to integrate scientific and technological developments of the recent decades in DRR activities because traditional resources often go underutilized due to a lack of organization [49]. However, many communities struggle to integrate scientific methods in developing DRR strategies, thus hindering adequate access to information, as scientific data requires large volumes of continuous temporal and spatial data coverage [49].

DRR activities have improved since the setting up of the NDRRMC in 2013 and have been oriented favorably towards participatory processes. These results were consistent with Haque and Uddin [50] who also stated that the landscape of disaster management has changed positively in recent decades, mainly in the low-income countries. The results were further supported by Kafle [51] who pointed out that at-risk communities should be at the center of the decision-making process and be actively engaged in the assessment and implementation of DRR measures. In another study, Bhagat [21] concluded that capacity building and training of disaster relief volunteers were the main focus of community-based disaster management since they are the first responders. Shaw [52] also identified communities as the first emergency responders in case of a disaster. He stated that there exists innovative community based DRR practices worldwide, and it is important to analyze and withdraw common lessons from them. Similarly, Yodmani [53] argued that community-based disaster risk management (CBDRM) techniques could eventually contribute to vulnerability reduction and capacity strengthening by preventing human, economic and environmental losses. Community empowerment is widely used in disaster management, and it has been used as a common method to build resilient communities by many NGOs and countries such as Indonesia, Philippines, and Bangladesh. While Rozi et al. [54] studied the contribution of religious values and local wisdom in CBAs, Badrudin [55] argued that CBAs consist of traditional relief measures whereby communities are either “victims” or “beneficiaries” of disaster relief assistance only.

Despite the massive efforts to improve public disaster education, poor levels of preparedness still prevail in many countries [56,57]. Past studies revealed that, although people knowingly live in hazardous environments, barriers to at-home-preparedness still exist, and, therefore, households’ disaster unpreparedness remains high [58,59]. Having an appropriate infrastructure such as a robust early warning system does not guarantee that most people will respond favorably to a disaster. In a study conducted by Nakamura [60], it was found that many inhabitants on the Ryukyu Islands of Japan were neither aware of the tsunami risk, nor did they know what the siren was meant for. Yadav and Barve [61] stated that CBAs can further be improved with the collaboration of relief agencies and NGOs such as the Red Cross to address gaps that overstretched government departments cannot fill. This was further supported by Gero et al. [62] who pointed out the importance of Community Based Health and First Aid in Samoa in the Pacific for successful implementation of DRR strategies. Hence, community-disaster communication and education strategies must take into consideration the community demographic characteristics such as age, education level, cultural beliefs, customs, and financial resources in terms of funding and infrastructural facilities.

6. Conclusion

This research paper identified the CBAs to Disaster Risk Reduction which have been executed in various administrative areas across Mauritius. Although the forms of CBAs varied from region to region, mobilization and awareness remained the core elements of such approaches.

O’Brien and O’Keefe [63] noted that community members are frontline actors in the disaster management process. Their active involvement in risk reduction measures helps to identify the root causes of their

vulnerability to disasters [64]. However, local communities cannot improve their resilience to natural hazards on their own. Long-term training of the personnel is also essential for sustainable community-based disaster risk reduction efforts in high risk areas. Many countries have already adopted a policy transition from a top-down process to a community-centered approach with a focus on building bridges between community members and key stakeholders [50]. Global frameworks such as the Sendai Framework for Disaster Risk Reduction 2015-2030 and UN Sustainable Development Goals 2030 also encourage active participation of community members.

Mauritius has also implemented Community-Based Disaster Management in its various laws and regulations, such as the National Disaster Risk Reduction and Management Act 2016. Rules and regulations provide guidelines on how to ensure adequate community participation when implementing disaster management activities. Ultimately, results from this study suggest that there is a need to implement the different forms of community-based disaster activities on a larger scale across Mauritius in order to maintain a reasonable level of public interest in hazard mitigation. The active engagement of community members in Mauritius may eventually enable local institutions to identify weaknesses in emergency relief operations and to learn from disaster experiences.

The main conclusions drawn from this study were:

- Four community based DRR methods have contributed to improve community resilience towards natural hazards in Mauritius, namely, community volunteering, contingency planning, simulation exercises and awareness campaigns;
- All four forms of capacity building activities have been successfully implemented in 15 regions out of 109, but none of which was found in the Municipal Council of Vacoas/Phoenix;
- There has been an extensive attempt to mitigate the impact of natural hazard events through simulation exercises;
- The most common form of simulation exercise was flooding;
- The region of Poste de Flacq along the North East coast has benefitted from the greatest number of simulation exercises;
- Exposure to awareness campaigns has been very low and can be further increased to reach out to a wider audience.

Author Contributions

The author read and approved the final version of the paper.

Conflicts of Interest

The author declares no conflict of interest.

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References

[1] Ministry of Local Government and Disaster Risk Management - Republic of Mauritius, *National disaster risk reduction and management policy 2020-2030*, 2016, 26 pages.

[2] T. A. Codreanu, A. Celenza, I. Jacobs, *Does disaster education of teenagers translate into better survival knowledge, knowledge of skills and adaptive behavioural change? A systematic literature review*, Prehospital and Disaster Medicine 29 (2014) 629–642.

[3] M. Aleksandrova, D. Malerba, C. Strupat, *World Risk Report "Building Back Better" through social protection*, Bündnis Entwicklung Hilft, Bochum: Ruhr University Bochum – Institute for International Law of Peace and Armed Conflict (2001) 33–37.

[4] National Audit Office, Ministry of Social Security, National Solidarity and Environment and Sustainable Development - Republic of Mauritius, *Performance audit report: Government response to mitigate the impact of flooding*, (2019) 1–32.

[5] I. Kelman, J. J. West, *Climate change and small island developing states: A critical review*, Ecological and Environmental Anthropology 5 (1) (2009) 1–16.

[6] Capacity for Disaster Reduction Initiative, *Mauritius: Disaster risk management: A capacity diagnosis*, (2020) 1–170.

[7] R. K. Sungkur, A. Kissoonah, *ICT for disaster management and emergency telecoms preparation, migration and recovery for the island of Mauritius*, Strengthening Disaster Resilience in Small States: Commonwealth Perspectives, 2019, Ch. 4, 67–85.

[8] E. Ruchama, K. Ansaram, *Assessment of disaster risk reduction practices in Mauritius*, in: J. M. Luetz, D. Ayal, (Eds.), Handbook of Climate Change Management: Research, Leadership, Transformation, 2021, pp. 3533–3559.

[9] N. K. Betchoo, *Developing a model of community participation in disaster management in Mauritius*, Journal of Multidisciplinary Engineering Science and Technology 5 (12) (2018) 9172–9175.

[10] N. K. Betchoo, *Engaging rural communities in sustainable development in Mauritius*, Journal of Multidisciplinary Engineering Science and Technology 2 (3) (2015) 370–375.

[11] L. Musango, L. Veerapa Mangroo, Z. Joomaye, A. Ghurbhurrun, V. Vythelingam, E. Paul, *Key success factors of Mauritius in the fight against COVID-19*, BMJ Global Health 6 (3) (2021) e005372 5 pages.

[12] I. Ferdinand, G. O'Brien, P. O'Keefe, J. Jayawickrama, *The double bind of poverty and community disaster risk reduction: A case study from the Caribbean*, International Journal of Disaster Risk Reduction 2 (2012) (2012) 84–94.

[13] F. Linnekamp, A. Koedam, I. S. A. Baud, *Household vulnerability to climate change: Examining perceptions of households of flood risks in Georgetown and Paramaribo*, Habitat International 35 (3) (2011) 447–456.

[14] M. Pelling, J. I. Uitto, *Small island developing states: Natural disaster vulnerability and global change*, Global Environmental Change Part B: Environmental Hazards 3 (2) (2001) 49–62.

[15] R. A. Walshe, G. C. Adamson, I. Kelman, *Helices of disaster memory: How forgetting and remembering influence tropical cyclone response in Mauritius*, International Journal of Disaster Risk Reduction 50 (2020) 101901 13 pages.

[16] A. Chacowry, *Community recovery and resilience building in the aftermath of flood hazards in the small island developing state of Mauritius*, Doctoral Dissertation University of Gloucestershire (2014) Cheltenham.

[17] A. Lizuka, *Developing capacity for disaster risk reduction: Lessons learned from a case of Sri Lanka*, Progress in Disaster Science 6 (2020) 100073 7 pages.

[18] G. McBean, C. Rodgers, *Climate hazards and disasters: The need for capacity building*, Wiley Interdisciplinary Reviews: Climate Change 1 (6) (2010) 871–884.

[19] A. A. Shah, R. Shaw, J. Ye, M. Abid, S. M. Amir, A. K. Pervez, S. Naz, *Current capacities, preparedness and needs of local institutions in dealing with disaster risk reduction in Khyber Pakhtunkhwa, Pakistan*, International Journal of Disaster Risk Reduction 34 (2019) 165–172.

[20] J. I. Uitto, R. Shaw, *Adaptation to changing climate: Promoting community-based approaches in the developing countries*, SANSAI: An Environmental Journal for the Global Community 1 (2006) 93–107.

[21] S. N. Bhagat, *Community-based disaster management strategy in India: An experience sharing*, PDPU Journal of Energy and Management (2013) 11–17.

[22] J. M. Ayers, S. Huq, *The value of linking mitigation and adaptation: A case study of Bangladesh*, Environmental Management 43 (2009) 753–764.

[23] M. K. Van Aalst, T. Cannon, I. Burton, *Community level adaptation to climate change: The potential role of participatory community risk assessment*, Global Environmental Change 18 (1) (2008) 165–179.

[24] I. Kelman, J. Mercer, *A knowledge integration tool for disaster risk reduction including climate change*, in: M. Lopez-Carresi, M. Fordham, B. Wisner, I. Kelman, J. C. Gaillard (Eds.), Disaster Management: International Lessons in Risk Reduction, Response and Recovery Earthscan London, 2014, pp. 287–299.

[25] S. S. Zubir, H. Amirrol, *Disaster risk reduction through community participation*, WIT Transactions on Ecology and the Environment 148 (2011) 195–206.

[26] H. A. Rahman, *Community based approach towards disaster management*, Asian Journal of Environment, History and Heritage 2 (2) (2018) 55–66.

[27] L. Pearson, M. Pelling, *The UN Sendai Framework for Disaster Risk Reduction 2015–2030: Negotiation process and prospects for science and practice*, Journal of Extreme Events 2 (1) (2015) Article Number 1571001 12 pages.

[28] C. Van den Heuvel, L. Alison, N. Power, *Coping with uncertainty: Police strategies for resilient decision-making and action implementation*, Cognition, Technology and Work 16 (2014) 25–45.

[29] W. B. Ten Brinke, B. Kolen, A. Dollee, H. Van Waveren, K. Wouters, *Contingency planning for large-scale floods in the Netherlands*, Journal of Contingencies and Crisis Management 18 (1) (2010) 55–69.

[30] D. E. Alexander, *Disaster and emergency planning for preparedness, response, and recovery*, Oxford University Press, USA, 2015, 1–20.

[31] A. K. Sikka, B. B. Rao, V. U. M. Rao, *Agricultural disaster management and contingency planning to meet the challenges of extreme weather events*, Mausam 67 (1) (2016) 155–168.

[32] R. Husein, *Localizing disaster risk reduction: A case study of community-based disaster preparedness in Bima and Palangkaraya Indonesia*, In IOP Conference Series: Earth and Environmental Science 989 (1) (2022) 1–12.

[33] I. J. Koenti, Disaster *management using a contingency approach in the special region of Yogyakarta*, In IOP Conference Series: Earth and Environmental Science 1030 (1) (2022) 012017 9 pages.

[34] C. P. D. Gundran, H. Y. Lam, A. C. A. Tuazon, J. V. Cleofas, F. B. Garcia, T. E. M. Puli, M. S. I. Magdales, *Enhancing mass casualty disaster management competencies through an integrated disaster simulation training program*, International Journal of Disaster Risk Reduction 78 (2022) 103124 21 pages.

[35] R. D. Tennyson, *Computer-based enhancements for the improvement of* learning, Annual Management AECT, Atlanta, 1987, Article ID 56806080, 14 pages.

[36] C. K. West, J. Snellen, T. K. S. Murray, *A report on the research and development of instructional simulation*, Final Report to the Defense Systems Management College Fort Belvoir, Virginia, 1991, 1–78.

[37] G. M. Mathbor, *Enhancement of community preparedness for natural disasters: The role of social work in building social capital for sustainable disaster relief and management*, International Social Work 50 (3) (2007) 357–369.

[38] O. Nahkur, K. Orru, S. Hansson, P. Jukarainen, M. Myllylä, M. Krüger, M. Rhinard, *The engagement of informal volunteers in disaster management in Europe*, International Journal of Disaster Risk Reduction (2022) 103413 14 pages.

[39] I. Buchori, A. Zaki, P. Pangi, A. W. Sejati, A. Pramitasari, Y. Liu, *Adaptation strategies and community participation in government-led mitigation projects: A comparison between urban and suburban communities in Pekalongan, Indonesia*, International Journal of Disaster Risk Reduction 81 (1) (2022) 103271 13 pages.

[40] B. Wisner, *Five years beyond Sendai-Can we get beyond frameworks?*, International Journal of Disaster Risk Science 11 (2020) 239–249.

[41] R. Shaw, *Overview of Community-Based Disaster Risk Reduction*, in: R. Shaw (Ed.), Vol.10 of Community-Based Disaster Risk Reduction, Community, Environment and Disaster Risk Management, Emerald Group Publishing Limited, Bingley, 2012, Ch. 2, pp. 3–17.

[42] Y. Liu, K. Yin, L. Chen, W. Wang, Y. Liu, *A community-based disaster risk reduction system in Wanzhou, China*, International Journal of Disaster Risk Reduction 19 (2016) 379–389.

[43] D. J. O'Reilly, D. C. Brandenburg, *Simulation and learning in disaster preparedness: A research and theory review*, Online Submission (2006) 763–770.

[44] R. J. J. Beerens, H. Tehler, *Scoping the field of disaster exercise evaluation-A literature overview and analysis*, International Journal of Disaster Risk Reduction 19 (2016) 413–446.

[45] D. Paton, D. Johnston, *Disasters and communities: vulnerability, resilience and preparedness*, Disaster Prevention and Management 10 (4) (2001) 270–277.

[46] A. Amri, D. K. Bird, K. Ronan, K. Haynes, B. Towers, *Disaster risk reduction education in Indonesia: challenges and recommendations for scaling up*, Natural Hazards and Earth System Sciences (2016) 595–612.

[47] M. Muzani, C. Setiawan, J. N. W. Schaduw, A. Awida, M. Munzir, *The obstacles hierarchy of school disaster preparedness implementation in mount sinabung area, Indonesia*, Frontiers in Education 7 (2022) 842990 17 pages.

[48] F. Chen, Z. Shirazi, L. Wang, *Building scientific capacity in disaster risk reduction for sustainable development*, Cultures of Science 4 (1) (2021) 40–54.

[49] Organization for Economic Cooperation and Development (OECD), *The challenge of capacity development: Working towards good practice*, OECD Papers 6 (1) (2006) 1–37.

[50] C. E. Haque, M. S. Uddin, *Disaster management discourse in Bangladesh: A shift from post-event response to the preparedness and mitigation approach through institutional partnerships*, in: J. Tiefenbacher (Ed.), Approaches to Disaster Management-Examining the Implications of Hazards, Emergencies and Disasters, IntechOpen, 2013, 1–230.

[51] S. K. Kafle, *Integrated community-based risk reduction: An approach to building disaster resilient*

communities, in: Annual International Workshop & Expo on Sumatra Tsunami Disaster & Recovery, 2010, 1–20.

[52] R. Shaw, *Community based approaches of sustainable development and disaster risk reduction, in sustainable development and disaster risk reduction*, Springer, 2016, Tokyo, pp. 207–214.

[53] S. Yodmani, *Disaster risk management and vulnerability reduction: Protecting the poor*, New York: The Center, 2001, pp. 1–36.

[54] S. Rozi, A. R. Ritonga, J. Januar, *Local community-based disaster management: The transformation of religious and local wisdom values in preparation to deal with natural hazards in West Sumatra, Indonesia*, Jàmbá: Journal of Disaster Risk Studies 13 (1) (2021) 1–7.

[55] A. R. Badrudin, *Issues of disaster management preparedness: A case study of directive 20 of national security council in Malaysia*, International Journal of Business and Social Science 3 (5) (2012) 85–92.

[56] M. K. Lindell, D. J. Whitney, *Correlates of household seismic hazard adjustment adoption*, Risk Analysis 20 (1) (2000) 13–26.

[57] D. Paton, L. Smith, D. Johnston, *Volcanic hazards: Risk perception and preparedness*, New Zealand Journal of Psychology 29 (2) (2000) 86–91.

[58] N. Kapucu, *Collaborative emergency management: better community organising, better public preparedness and response*, Disasters 32 (2) (2008) 239–262.

[59] D. King, *You're on your own: Community vulnerability and the need for awareness and education for predictable natural disasters*, Journal of Contingencies and Crisis Management 8 (4) (2000) 223–228.

[60] M. Nakamura, *Source fault model of the 1771 Yaeyama tsunami, southern Ryukyu Islands, Japan, inferred from numerical simulation*, Pure and Applied Geophysics 163 (2006) 41–54.

[61] D. K. Yadav, A. Barve, *Role of capacity building in disaster preparedness: A case of cyclone Phailin*, Proceedings of the 17th Annual International Conference of the Society of Operations Management, 2014, pp. 980–985.

[62] A. Gero, K. Méheux, D. Dominey Howes, *Integrating community-based disaster risk reduction and climate change adaptation: Examples from the Pacific*, Natural Hazards and Earth System Sciences 11 (1) (2011) 101–113.

[63] G. O'Brien, P. O'Keefe, *Managing adaptation to climate risk: Beyond fragmented responses*, Routledge, London (2014) 1–210.

[64] B. Wisner, P. Blaikie, T. Cannon, I. Davis, *At risk: Natural hazards, people's vulnerability and disasters*, Routledge, London (1994) 1–134.