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Overcoming Challenges in Earthquake Preparedness in Panay Island in the Philippines through Good Governance

RAMIL B. ATANDO[1]

ABSTRACT. Disaster risk reduction is a major concern especially among developing and underdeveloped countries. This case study reviewed the governance strategies in place to manage the potential impacts of a magnitude 7.0 earthquake in Panay Island, which is home to more than 2 million inhabitants. National and local government offices engaged in disaster management provided the secondary data needed for this case study. Key informant interviews were conducted to collect salient information on governance strategies employed such as on fund sources and major players. Triangulation was employed to enhance the analysis and credibility of this research. Among the key findings is that an active fault, a trench, and a collision zone may generate another destructive earthquake in the future. However, good governance as a result of collaborations among public, private, and civil society organizations may reduce the vulnerability of communities in Panay Island to tsunami and other earthquake hazards. Public officials of underdeveloped and developing countries searching for alternative management strategies to supplement their minimal resources in managing impacts of earthquakes may be able to apply the strategies presented in this case study.

Keywords: *collaboration, earthquake generators, governance, partnership*

[1]*College of Management, University of the Philippines Visayas, Iloilo City, Philippines*
https://orcid.org/0000-0003-0046-3059
rbatando@up.edu.ph

INTRODUCTION

The lack of an effective early warning system for tsunami had claimed hundreds of thousands of lives in Indonesia and other developing countries in Asia (Jayarathne, 2016). These disasters emphasize the importance of strengthening disaster risk reduction and management (DRRM) capabilities of local officials of earthquake-prone communities in underdeveloped and developing countries to minimize damage from these calamities.

Earthquakes are not new to the Philippines as the country is within the Pacific Ocean's Ring of Fire. In recent years, several damaging events were recorded in Negros Oriental (2012); Bohol (2013); and Surigao del Norte (2017) (Philippine Institute of Volcanology and Seismology [PHIVOLCS], 2017a). About three decades ago, in 1990, a catastrophic earthquake hit Luzon in Northern Philippines, which resulted in thousands of deaths. This earthquake event prompted public officials both at the local and national levels to craft countermeasures.

This paper scrutinizes the governance strategies in managing the potential impacts of earthquakes in Panay Island. The 1,169,247-hectare island is home to the provinces of Aklan, Antique, Capiz, and Iloilo (Department of Environment and Natural Resources, 2018). It has a population of around 2.4 million (Philippine Statistics Authority, 2016). Iloilo City, the center of government and business in the region, is the 5th most populated highly urbanized city outside Metro Manila. In 2017, it posted a 6.1% economic growth (National Economic and Development Authority, 2017). A magnitude 7.1 earthquake struck Panay Island on 14 June 1990 (Bautista et al., 2011).

The next section walks the reader through the legal framework on DRRM in the Philippines. It also gives an overview of theoretical insights on disaster management. The conceptual framework of the paper follows, which draws upon several prescribed norms on effective disaster management. A detailed account in doing this case study is presented in the methodology section. The results and discussion section then follows, which provide detailed responses to the research questions set forth in this paper. The paper concludes with the conclusion and recommendations section. Recommendations range from organizational to policy insights.

Disaster Risk Reduction and Management in the Philippines

Managing impacts of disasters such as earthquakes is among the key priorities highlighted in major global (e.g., the UN Sustainable Development Goals) and national (e.g., Philippine's *Ambisyon Natin* 2040) policy documents. In the Philippines, the Philippine Disaster Risk Reduction and Management Act of 2010 (RA 10121) stipulates that local government units must appropriate 5% of their annual budget to disaster management. The 70 percent of the total allotment, however, could only be spent during and after the occurrence of a disaster. The Philippine government is accused of being reactive in its response to natural disasters since only a third of the resources are appropriated to countermeasures (Office of Civil Defense, 2011; World Bank, 2017). Significant major reforms were enacted in 2010. Among them is the provision that allows the use of 70 percent of DRRM funds for preparedness measures—a practice that was previously prohibited (La Viña & Tan, 2015). The remaining 30 percent is reserved for response and recovery activities. The Office of the President shall release an additional allotment in case a local government unit declares a state of calamity as stated in RA 10121. Moreover, the provisions in RA 10121 are aligned with the Hyogo Framework for Action 2005-2015. Current DRRM programs and projects nationwide are also patterned with the Sendai Framework for Disaster Risk Reduction 2015-2030.

Theoretical Insights on Managing Disasters

Bringing together non-governmental and governmental actors in addressing the increasing complexity of public services, mounting fiscal constraints, less accessible health services, and immigrant integration issues is an effective strategy in service delivery (Kang et al., 2019; Radevic & Hacek, 2019; Els & Bloemraad, 2017). The concept of an "organizational society" seeks to provide important services through multi-organizational programs that are "interconnected clusters of firms, governments, and associations which come together within the framework of these programs" (Hjern & Porter, 1981, p. 214).

Scholars propose that new and suitable concepts in managing public affairs must be observed (Hartley, 2010; Irshad, Ali, & Iqbal, 2015; Malalgoda, Amaratunga, & Haigh, 2016) such as partnerships (Carley, 2000; Lasker, Weiss, & Miller, 2001; Bäckstrand, 2006; McGuire & Silvia, 2010) and collaborations (Denhardt & Denhardt, 1999; Ullah, Newell, Ahmed, Hyder, & Islam, 2006; Murray, Haynes, & Hudson, 2010; Tang, Chen, & Shao, 2018). Risk assessment and disaster preparedness

programs in communities susceptible to earthquake hazards lessen the casualties while making people more adaptive (Chou & Wu, 2014). For these programs to be effectively carried out, collaboration with various organizations is necessary. This argument is shown best in a business where firms collaborate to share and decrease market and technological uncertainties (Caloghirou, Hondroyiannis, & Vonortas, 2003). Local governments with lesser financial resources and less private capacity are likely to establish more collaborative partnerships with other institutions (Im, Jeon, & Kim, 2017). These theories, proven effective in other areas of public affairs such as in local governance and even in running a business, will work in DRRM. It is because disaster management also involves maximizing the use of available resources to achieve the set objectives.

The overarching research question of this study is: How does Panay Island prepare for a catastrophic earthquake? The following are the specific research questions of this study: 1) What are the mapped active fault, trench, and collision zone on and adjacent to Panay Island that may generate a tsunami and other earthquake hazards?; 2) Were there damaging earthquakes with a magnitude of 7.0 and above that hit the Island from 1600 to 2018?; 3) After a magnitude 7.1 earthquake shook this area on 14 June 1990, what are the government's DRRM projects in preparation for the recurrence of another deadly earthquake?; and (4) What are the alternative management strategies that enhance local government officials' capacity to implement these initiatives?

Conceptual Framework

There are several prescribed norms for effective disaster management (e.g., Grobicki et al., 2015; Bang et al., 2019). Figure 1 highlights the components of information, education, and communication campaigns before the occurrence of a disaster (Reynolds & Seeger, 2005).

In public administration, scholars continue to search for the best ways in governing public affairs. For example, the concept of "governance" has replaced the old idea of "government," and recently "good governance" has dominated the discourse of institutions advocating for human and community developments (Nag, 2018). All this is geared towards equipping government officials to better manage public affairs.

There is evidence to show that adherence to principles of good governance results in tangible development in communities and their inhabitants (United Nations Development Programme, 1997). Figure 2 shows the eight key indicators of good governance: accountable,

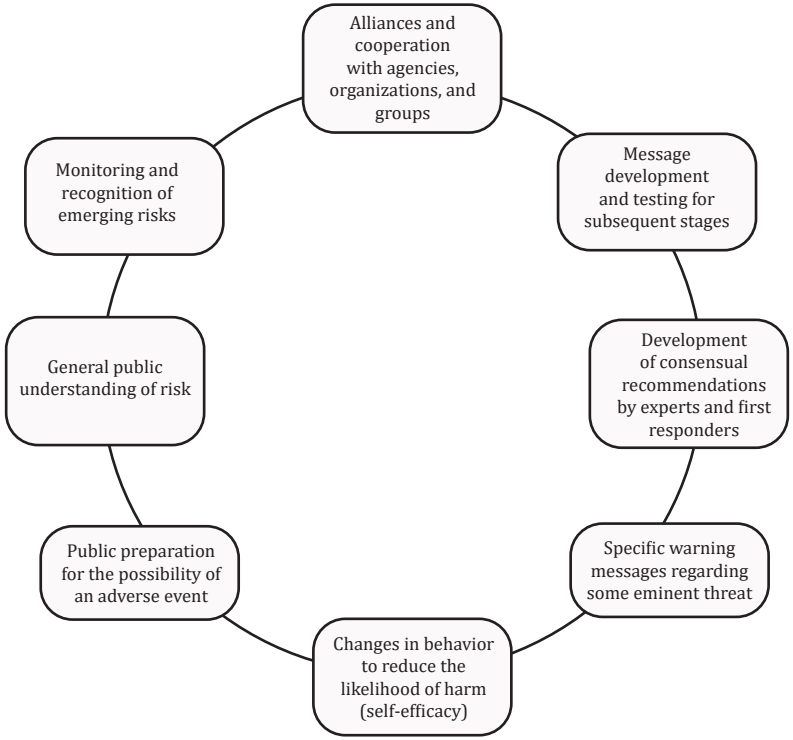

Figure 1. A pre-crisis model for information, education, and communication campaigns

transparent, responsive, equitable and inclusive, effective and efficient, follows the rule of law, participatory, and consensus-oriented. It is assumed that the mainstreaming of these parameters in disaster management among local government units is expected to result in holistic development.

METHODOLOGY

In this case study, the secondary data were sourced from national government agencies and local government units involved in carrying out earthquake preparedness projects in Panay Island. The national government agencies that provided data for this study were PHIVOLCS, Office of Civil Defense (OCD), National Disaster Risk Reduction and Management Council (NDRRMC), Philippine Statistics Authority (PSA), National Economic and Development Authority (NEDA), and Mines and

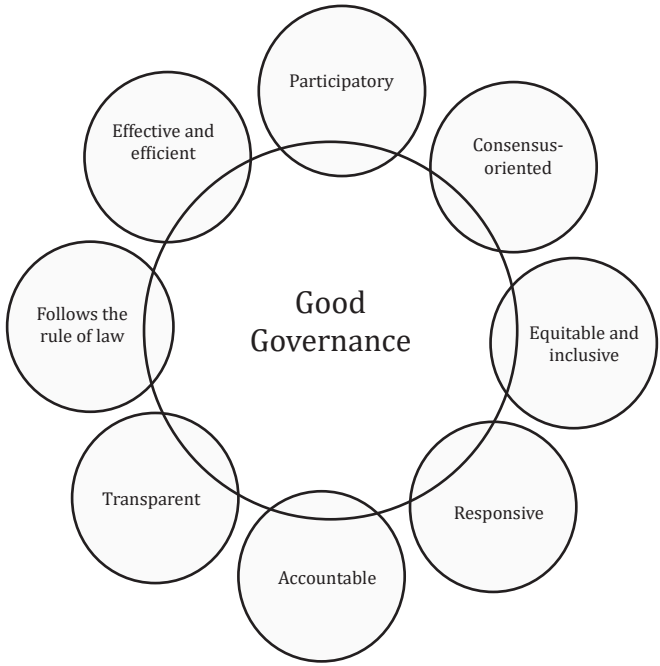

Figure 2. The eight key indicators of good governance

Geosciences Bureau (MGB). The Provincial Disaster Risk Reduction and Management Offices (PDRRMO) of Aklan, Antique, Capiz, and Iloilo also provided data on completed DRRM projects. Table 1 shows the comprehensive list of secondary data collected and their respective sources.

Interviews with DRRM project staff members in each province were conducted to know the methods involved from planning to evaluation stages. Each DRRM project was analyzed in terms of how the government reinforced its limited financial and technical resources. The stakeholders and collaborators were likewise identified. Analysis of details of these DRRM projects was conducted to specify the alternative management strategies that helped local government officials enhance their capacity to implement these initiatives. Insights from said information were also used to determine the practitioners' observance of the two frameworks highlighted in this study (*see Figures 1 and 2*). The projects implemented were arranged chronologically, that is, from 1990 to 2018. Triangulation of interview results was made to validate the integrity of the information provided by the interviewees (Denzin,

1978 as cited in Raphael et al., 2003). This enabled the researcher to scrutinize each earthquake countermeasure.

As for the technical aspects of this research particularly on the science surrounding earthquakes, references from academic journals as well as grey literature authored by seismologists, geologists, and disaster managers were consulted. These references enabled the researcher to identify the active fault, trench, and collision zone that may generate a tsunami and other earthquake hazards in Panay Island. These references also led to the review of damaging earthquakes that hit this area in the past four centuries, that is, from 1600 to 2018.

Table 1. Sources of secondary data

Sources	Secondary data
Mines and Geosciences Bureau (MGB)	- Multi-hazards mapping project in Panay Island
National Disaster Risk Reduction and Management Council (NDRRMC)	- Total number of casualties in Panay Island in the 2013 Super Typhoon Haiyan (Yolanda)
National Economic and Development Authority (NEDA)	- Economic growth and regional center of business in Panay Island
Office of Civil Defense (OCD)	- Collaborative DRRM projects with the PHIVOLCS and 4 PDRRMO in Panay Island
Philippine Institute of Volcanology and Seismology (PHIVOLCS	- Earthquake generators in and adjacent to Panay Island - Damaging earthquakes in Panay Island since 1600 - Collaborative DRRM projects with other countries, foreign-funding institutions, other national government agencies, and local government units
Philippine Statistics Authority (PSA)	- Total population in Panay Island
Provincial Disaster Risk Reduction and Management Office (PDRRMO) in Panay Island	- Collaborative DRRM projects with the PHIVOLCS and Office of Civil Defense
United Nations Development Programme (UNDP)	- Multi-hazards mapping project

RESULTS AND DISCUSSION

Earthquake Generators on and Near Panay Island

According to PHIVOLCS (2019a), three earthquake sources threaten Panay Island with tsunami and other earthquake hazards (Figure 3). First is the West Panay Fault that transects the western part of the island from north to south. The traces were found in the municipalities of Libacao, Madalag, Ibajay, and Malinao (Aklan); Pandan and Valderrama (Antique); Jamindan and Tapaz (Capiz); and Alimodian, Igbaras, Janiuay, Lambunao, Leon, Miagao, San Joaquin, Tubungan, and Maasin (Iloilo). Second is the Collision Zone in Mindoro Strait, which is situated west of the Island. This earthquake generator puts at risk most of the coastal barangays in the Province of Antique to 6 – 11-meter high tsunami. The third is the Negros Trench in the Sulu Sea located south of Panay. In case it triggers a major earthquake, tsunami waves will endanger the southern and central coasts in the provinces of Antique and Iloilo 15 minutes after the mainshock. Most of the shorelines in Iloilo Province are expected to be washed away by 9 – 12-meter high tsunami waves (PHIVOLCS, 2019).

When the Central Negros Fault in the southeast generates a magnitude 7.0 earthquake, ground shaking can also be felt in Panay. Likewise, the Philippine Fault Zone Masbate segment, northeast of the Island, had been generating large earthquakes in the past, which were moderately felt in northern Panay Island.

Panay Island: Highly Prone to Tsunami and Other Earthquake Hazards

Bautista et al. (2011) reported that five major earthquakes ranging from magnitude 7.1 to 8.2 had hit this Island in the past 400 years (Table 2). The epicenters were concentrated on the western part where the active West Panay Fault was traced. Details of recorded damages to structures can be found in the archives of the Roman Catholic Church in Jaro and the National Library as well as from the narrations of local historians. The 24 January 1948 earthquake was the second largest to hit the Philippines. The newspapers Manila Bulletin and Manila Times published about this disaster in their January 1948 issues. There were 55 Catholic churches built in the 1600s, including the Miagao Church, which is a UNESCO World Heritage site, that were damaged by earthquakes.

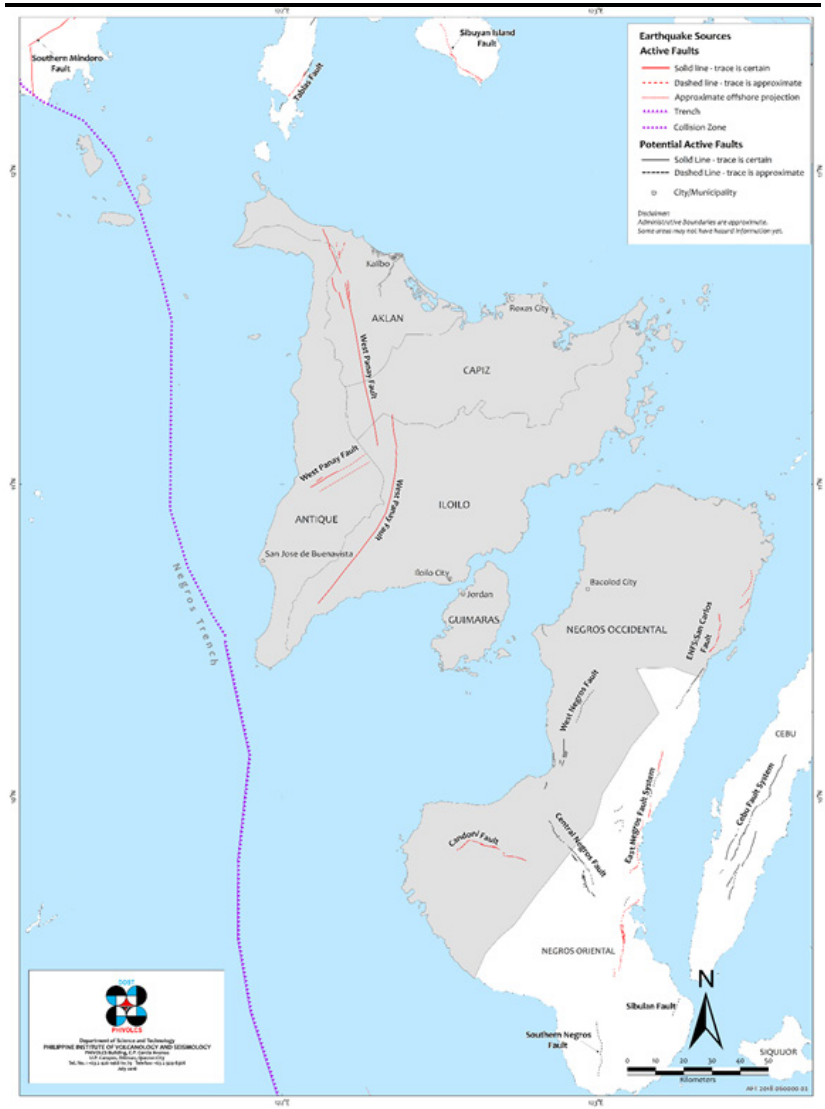

Figure 3. Earthquake generators in and adjacent to Panay Island

These data show that Panay Island has long been highly vulnerable to damaging earthquakes. The chance is high that it will be shaken again once there is a sudden displacement of rocks or rock materials beneath the surface of its earthquake generators. If the magnitude of the earthquake exceeds 6.5, tsunami and other hazards will worsen the intense ground shaking depending on the location of the epicenter. The number of casualties and extent of damage to structures and public utilities are also expected to increase.

Table 2. Damaging earthquakes that hit Panay Island, Philippines since 1600 (Bautista et al., 2011)

Date of Occurrence	Magnitude
December 1621	7.2
July 12, 1787	7.4
February 2, 1887	7.3
January 24, 1948	8.2
June 14, 1990	7.1

DRRM Projects in Panay from 1990 to 2017

There were numerous state-initiated DRRM projects implemented nearly three decades ago to protect the 2.4 million people in Panay Island from earthquake risk. These projects are discussed below. The enactment of RA 10121 in 2010 resulted in the realization of additional DRRM projects.

Global Positioning System (GPS) Project. The GPS project funded by the Philippines' Department of Science and Technology (DOST) is a continuous annual project in Panay Island (PHIVOLCS, 2017). A memorandum of agreement among collaborators allows GPS receivers to be temporarily mounted on government-owned properties for seven days to record the exact coordinates and elevation of the sites. Newly collected data are compared with previous ones to determine any changes. This project endeavors to determine the direction and velocity of the slow movement of the archipelago toward the South China Sea in response to the continuous collision of the Pacific Plate against the Philippine Sea Plate. It helps seismologists to determine the probability of an earthquake as the continuous movement of blocks, detected by GPS receivers, creates strain that consequently causes energy buildup. This stored energy is released during an earthquake. GPS data can also identify the direction of movement of an active fault, which suddenly moves during a destructive earthquake. Among its collaborators are the governments of Taiwan and France. In 2018, the government installed a continuous GPS that records data transmitted in real-time to the PHIVOLCS central office in Manila.

24/7 Earthquake Monitoring Stations. Panay is the only island in the Philippines with three staff-controlled earthquake monitoring stations (PHIVOLCS, 2019). These are situated in the provinces of Antique,

Aklan, and Capiz. These stations were modernized with support from the Japan International Cooperation Agency (JICA). Since 2001, the stations have been equipped with state-of-the-art seismographs, seismometers, accelerometers, and intensity meters. The staff members (called observers) also underwent training on seismology and on managing an earthquake monitoring station in Japan, Germany, and Taiwan.

An observer is in charge of the field office during office hours. Outside office hours, only a caretaker manages the office. The seismologist who is required to render services eight hours a day is on call and receives overtime pay. He leaves the office when he pays bills, attends meetings, participates in training programs, gives lectures, and evaluates earthquake drills. This inadequacy of personnel complement may result in ineffective earthquake monitoring.

Hazard Mapping and Assessment for Effective Community-Based Disaster Risk Management (READY) Project. This project aimed to come up with multi-hazard maps at a village-level scale. Filipino experts did the field survey and mapping activities with financial support and additional technical assistance from foreign agencies. Provinces highly prone to natural disasters were identified. Field surveys in Antique and Iloilo were conducted in 2009 before the production of expert-reviewed digital and analog maps. Upon project completion, information, education, and communication materials were distributed to local governments along with the conduct of seminar-workshops and distribution of hazard maps (Mines and Geosciences Bureau Region 6, 2009; PHIVOLCS, 2018). The hazard maps are available for download from the websites of agencies involved in the project. The project, however, fell short in completing the information, education, and communication materials for tsunami and village-level drills due to budget constraints. The OCD; Philippine Atmospheric, Geophysical, and Astronomical Services Administration (PAGASA); National Mapping and Resource Information Authority (NAMRIA); and PHIVOLCS collaborated with UNDP and Australian Agency for International Development in implementing this project.

Quick Unified Inventory of Vulnerability and Exposure for Rapid Earthquake Damage Assessment System Project. This project was conducted in Iloilo City in 2010. Surveyors from partner-agencies assessed the buildings in Jaro District and conducted a simulation of possible impact of two damaging earthquakes at magnitude 6.3 and 8.1. The outputs were estimated number of casualties and percentage of collapse among building types. Geoscience Australia published an online reference book featuring the output of this project.

Limited units of expensive Personal Digital Assistants from Australia were used during the first of the three series of building surveys. Since it would be very costly for the Philippine government to buy these portable devices costing around PhP 200,000 (approx. US$385) each, PHIVOLCS installed to netbooks and laptops the application used in building assessment. An external web camera and a portable GPS receiver were connected to each laptop or netbook to take the photos and to get the coordinates of the surveyed buildings, respectively. This innovation, which resulted in efficient and effective governance, was presented during the 9th Pacific Conference on Earthquake Engineering in New Zealand in 2011. The Risk Analysis Project in Metro Manila was a replication of this pilot project.

This project was a collaboration between Geoscience Australia and the Philippine government. The Philippine agencies that participated in this project were PHIVOLCS, University of the Philippines Institute of Civil Engineering, the local government of Iloilo City, and the Regional Offices of OCD and DOST.

Information, Education, and Communication Activities and Earthquake Drills. The various partnerships between the national government and the local DRRM offices on disaster mitigation and adaptation were enhanced through the conduct of frequent capability-enhancement training programs; information, education, and communication activities; and earthquake drills in schools, hospitals, villages, and offices. The activities started in 2011 in compliance with RA 10121. The activities proceeded smoothly without any formal arrangements with different stakeholders. The International Organization for Migration, Adventist Development and Relief Agency, Save the Children, Hilfswerk der Evangelischen Kirchen Schweiz of Switzerland, Red Cross, and other charitable institutions sponsored a series of information, education, and communication activities on various natural disasters post-Super Typhoon Haiyan (PDRRMO of Capiz, personal communication, May 10, 2017). From 2013 to 2015, PHIVOLCS (2018) reported a significant increase of facilitated lectures on earthquake preparedness nationwide. Among the key issues reported concerning earthquake drills was the non-participation of some organizations, in particular, the private offices and commercial establishments. They considered the earthquake drills to be disruptive of their operations.

Online Earthquake Intensity Meters. The Japanese Government donated 110 intensity meters through the JICA, Japan Science and Technology Agency (JST), and National Research Institute

for Earth Science and Disaster Resilience (PHIVOLCS, 2018). These intensity meters are mounted in the offices of local government units nationwide following the approval of the memorandum of agreement by the respective local legislative bodies. There are 10 intensity meters installed in Panay Island since 2010. LGUs supply both the needed power and internet connectivity while the national government maintains and upgrades the system. Some units, which the JICA donated, are solar-powered. Additional units are provided every year. In case of software malfunction, a staff member from the main office of PHIVOLCS in Manila is tasked to do remote troubleshooting. Repair is done using the "Team Viewer" application.

The output of continuous monitoring of ground movement is visible both at the installation site and at the PHIVOLCS central office in Metro Manila. Since real-time intensities of the earthquake are transmitted through the internet, instrumental intensities are included in the first earthquake bulletin issued 5-15 minutes after the event. In the past, government seismologists made telephone calls in areas, which felt the tremor before the final felt intensities could be determined.

Rapid Earthquake Damage Assessment System (REDAS) Training Programs. From 2012 to 2018, there were about 80 public officers and staff members from the national and local governments in Aklan, Antique, Capiz, and Iloilo who participated in the four series of training programs on the use of REDAS software. Developed locally in 2004, it is given for free to trained users, and has features similar to the expensive Geographic Information System software developed by multinational companies. An End-User License Agreement is issued to trainees before using the software. Its developer, Dr. Bartolome Bautista of PHIVOLCS, updates it almost every month.

REDAS can identify multi-hazards that pose danger to communities, simulate damaging earthquakes, and determine the areas that will most likely be affected by a tsunami and other hazards. The outputs proved useful in formulating and revising local governments' Comprehensive Land Use Plan. The trainers extended their services free of charge while the host local government arranged for the logistics needed for the training. Applying the concept of equity in access to training programs, the UNDP and PHIVOLCS covered the expenses of the participants coming from provinces that are highly prone to earthquake hazards. The second round of training was held in Iloilo City in October 2018 in partnership with a private maritime university and with the city government. The school offered the venue while the Iloilo City government covered the rest of the expenses.

The REDAS Team showcased lateral collaboration in government as the trainers came from the different divisions of PHIVOLCS. The functions of speakers in their offices were not neglected given that they were not permanent team members. Likewise, only one training session was conducted in a month. The multi-hazard maps that the users can access in this software were the outputs of collaboration among the MGB, PAGASA, NAMRIA, and PHIVOLCS (PHIVOLCS, 2019b).

Speakers' Bureau. The Province of Capiz formed a Speakers' Bureau in 2013. It was composed of experts from government agencies such as PHIVOLCS, PAGASA, Bureau of Fire Protection (BFP), Philippine Information Agency, Capiz State University DRRM Office, and the PDRRMO of Capiz. Organizations requesting for a lecture on DRR and earthquake and fire drills coordinated with the PDRRMO of Capiz, which was in charge of scheduling and dispatching of experts. The speakers and evaluators extended their services free of charge (PDRRMO of Capiz, personal communication, May 10, 2017). Despite not having any formal agreements among collaborating agencies, the activities proceeded smoothly. A major concern noted was the unavailability of speakers on some occasions owing to more important functions.

Tsunami Sensors/Sirens. All coastal towns in the province of Antique and the shorelines in the municipalities of Leganes down to San Joaquin in the province of Iloilo are tsunami-prone (PHIVOLCS, 2017b; PHIVOLCS, 2017c). Possible sources of life-threatening giant waves are the Mindoro Strait and the Sulu Sea where the Collision Zone and Negros Trench, respectively, are located. The local chief executives are aware of this information. Additionally, this information served as the basis for the development of various projects supported by the national government. Among these projects are the Tsunami Early Warning System, Science and Technology Research Partnership for Sustainable Development, and the Community-Based Early Warning System for Tsunami. A community-based early warning system drill for a tsunami was conducted in the village of Botbot, Pandan, in northern Antique in August 2016. The expenses were covered by the national and local government units. Consultations with village officials were conducted before finalizing the schedule of activities.

Since 2013, tsunami sensors and sirens had been installed in Iloilo and Antique to alert people of incoming giant sea waves. A memorandum of agreement between PHIVOLCS and the local governments (sometimes with the Philippine Ports Authority) was signed before the installation of instruments. The JICA, JST, AND DOST funded these projects capable of transmitting real-time data to the PHIVOLCS central office. A siren located

in a populated area is activated once sensors detect signs of triggered tsunami waves. Local governments, in partnership with the developer, the DOST, were advised by PHIVOLCS to increase the number of these sirens. Signage was also put up in tsunami-prone areas, evacuation routes, and evacuation areas. The Philippines regularly participates in the Pacific Tsunami Drill to test the capability of its responders. The national government continually expands its network of tsunami sensors. Vandalism is a key issue noted in this project despite the enactment of the Risk Reduction and Preparedness Equipment Protection Act (RA 10344), a law penalizing the unauthorized taking, stealing, keeping, or tampering of government risk reduction and preparedness equipment, accessories, and similar facilities.

Evacuation Centers. The PDRRMO of Capiz (personal communication, May 10, 2017) reported that the OCD collaborated with the Department of Public Works and Highways (DPWH) and local governments to build larger, world-class evacuation centers post-Super Typhoon Haiyan in 2013. Switzerland's Interchurch Aid HEKS also funded the construction of additional evacuation centers in areas highly vulnerable to flood and other hydrological hazards. These structures are resistant to earthquakes and typhoons. The OCD and nongovernmental organizations financed the structure while local governments donated the lot suited for evacuation purposes. In Capiz, for example, as of this writing, there are new evacuation centers in Roxas City and in the municipalities of Pontevedra, Panay, and Pilar. Super Typhoon Haiyan heavily damaged these areas in 2013.

Guides for Safe Houses. An information material titled "How safe is my house?" was published in 2014 by PHIVOLCS. It contains a self-check for earthquake safety of small buildings in the Philippines made of concrete hollow blocks. Reliable and easy-to-follow guides in constructing an earthquake-proof structure are detailed with corresponding illustrations. This communication material was distributed during lectures on earthquake hazards and preparedness. Selected architects and civil and structural engineers from local governments and other national offices were trained on how to use the guide. The trainees were required to conduct re-echo seminars upon return to their respective offices. The production of this communication material was a part of a collaborative project among the Association of Structural Engineers in the Philippines, JICA, PHIVOLCS, and JST (PHIVOLCS, 2014).

Response to Tsunami Hoax. Thousands fled their homes on 1 and 2 December 2013 following the rumored tsunami that was spread through social media and text messages in Antique, Iloilo, and Capiz.

The unrestored power supply, destroyed by Super Typhoon Haiyan, contributed to the fast spread of the rumor. While some residents did not evacuate, others, especially those who were traumatized by Super Typhoon Haiyan, left their houses (Rendon & Celino, 2013; Paz & Fuertes, 2013).

Local government officials, PHIVOLCS, OCD, and DRRM offices advised people through a roving vehicle with loudspeakers and broadcasts in radio and TV stations to disregard the rumor. This intervention was only partially effective as those that did not have a power supply moved to the nearest hills and mountains. In Capiz, DYOW Bombo Radyo, a private radio station, made an emergency broadcast at midnight to stop the rumor-caused mass evacuation. People returned home after some time. Thieves might have originally spread the rumor to loot houses left by panicking residents. The incident suggested that some locals remained unaware that a strong earthquake must precede a tsunami. Most residents, however, stayed home because of their increased knowledge that earthquakes could not be predicted. The summary of government's earthquake countermeasures in Panay Island from 1990 to 2018, which aim to mitigate the impacts of another deadly earthquake, is shown in Figure 4.

As part of disaster response, the local governments entered into memorandum of agreements with grocery stores for the immediate supply of food products during calamities payable on a credit basis. The state-owned National Food Authority supplied rice after the disaster. The heavy equipment in the engineering offices of local government units

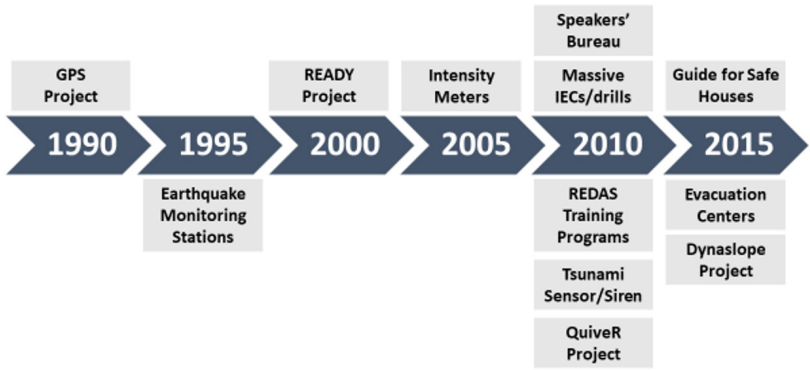

Figure 4. The government's DRRM initiatives in Panay Island from 1990 to 2018

were utilized during the response stage. The mandatory membership of local governments and some national government agencies to the Regional and National DRRM Councils entitled them to receive assistance from the Armed Forces of the Philippines. Local governments also tapped the resources of other national offices such as the BFP, DPWH, and the Philippine National Police. Responders from international nongovernmental organizations and other entities were also tapped to help the government as necessary.

The rescue personnel adapted to the new setup of being awake and well-prepared round the clock since they respond to all emergency calls. Government responders became more visible after the purchase of ambulances, hiring of additional staff members, and installation of telephone lines and battery-operated communication equipment in 2011. Moreover, all levels of educational institutions have adapted to the yearly earthquake drills.

Challenges and Opportunities in Earthquake Preparedness

The high susceptibility of local communities to catastrophic earthquakes challenges its public officials to look for novel ways that can reinforce their financial and technical resources. Most local government units, however, are not used to seeking assistance from foreign funding institutions. Among the reasons for this is the difficulty in making project proposals and that the system of planning, monitoring, and evaluating in these institutions are different from the practice in the bureaucracy.

In the case of Panay Island, the communities benefited from collaborations with other countries, foreign funding institutions, international nongovernmental organizations, and national government agencies. Since national government agencies search for earthquake-prone local government units to become project beneficiaries, the local governments in Panay Island took advantage of these opportunities. They offered to share the cost of realizing different initiatives such as providing building space or parcels of land. This resulted in carrying out a number of DRRM projects while not draining the local government coffer. This sharing of strengths resulted in stronger organizations (Figure 5).

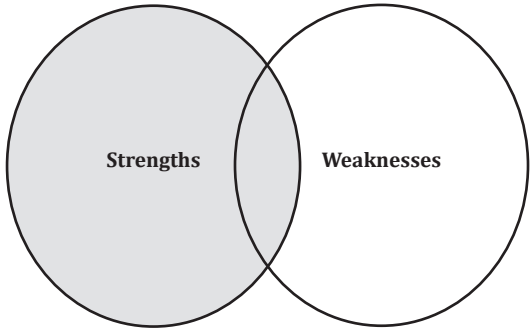

Figure 5. The strengths of an organization compensate for its weaknesses

Alternative Management Strategies to Overcome Challenges in DRRM

To augment the government's resources allotted to protect its earthquake-prone communities against natural hazards, Panay Island utilized the management strategies of partnership and collaboration. These approaches are among the eight components of the pre-crisis model for information, education, and communication (Reynolds & Seeger, 2005). Partnership denotes associations of institutions and community agencies that join forces to address common concerns and achieve communal outcomes. On the other hand, the aim of collaboration is for collaborating entities to work jointly with others by taking on specified tasks within the project and sharing responsibility for its success (Andersen, Ansari, Rasmussen, & Stock, 2010).

To facilitate pooling of resources, each collaborator needs to adapt the culture of others which might be different from theirs. Locally, PHIVOLCS showed flexibility by agreeing to the preferred schedule of the local communities in the conduct of information drives for tsunami and earthquake drills. There were times when these events were conducted on weekends or at nighttime. Sacrifice enabled the project to achieve its goals. In other parts of the country, civil defense officials collaborated with the Department of Social Welfare and Development to reward the involvement of household members in earthquake drills with simple tokens such as 2 kg of rice, canned goods, and instant noodles. This strategy has been shown to increase the level of people's participation in community activities (Kohn, 1999 as cited in Fahey et al., 2007; Gram, 2019).

In the Province of Capiz, schools, hospitals, and offices scheduled the orientation and earthquake drill according to the availability of the Speakers' Bureau. Collaborators must fulfill the roles that are expected of them. This is important as if local government units are uncooperative, national government agencies and foreign funding institutions will cease further collaboration efforts and look for other local governments which are adaptive and flexible.

The various DRRM projects also integrated the seven remaining components of Reynolds and Seeger's (2005) pre-crisis model for information, education, and communication—monitoring and recognition of emerging risks; general public understanding of risk; public preparation for the possibility of an adverse event; changes in behavior to reduce the likelihood of harm (self-efficacy); specific warning messages regarding some eminent threat; development of consensual recommendations by experts and first responders; and message development and testing for subsequent stages. These were the goals of a number of earthquake countermeasures in the island.

The ample preparations were not yet tested for a disastrous earthquake because only weak to mild shaking ranging from magnitude 3.0 to 5.0 had struck the region after its magnitude 7.1 event in 1990. While this is the case, the people and institutions that contributed to these initiatives have already been recognized both at the local and national levels. Additionally, the Panay Island reported relatively lower number of casualties (292 out of 6,300) compared with other provinces during the Super Typhoon Haiyan disaster (NDRRMC, 2015). While this is not a cause for celebration, this is an indication of an improved disaster response mechanism in place.

Good Governance: Integrated to DRRM Projects

In planning and implementing effective yet efficient earthquake preparedness projects, the eight key indicators of good governance that the UNDP (1997) had proposed were observed. The barangay officials were empowered through their engagement in scheduling the community-based tsunami information, education, and communication activities and drills; inviting institutions and evaluators agreed in including fire, casualties, and rescue scenarios prior to the conduct of an earthquake drill; and signatories in the formal agreements settled differences before the agreements were approved and notarized. These practices manifest consensus-orientation and the rule of law.

The involvement of all occupants in the building during the drill signifies inclusive governance while the exemptions for hypertensive and pregnant women and assistance provided to persons with disabilities denote equity. The presentation of comments and recommendations by evaluators to host organizations before the end of drills denotes transparency. There is rule of law since these initiatives were conducted in compliance with the provisions of RA 10121.

One of the recent concepts that Management and Public Administration scholars endorse is trusting in the efficacy of collaboration. The role of government should be transformed from one of controlling to one of agenda setting, bringing proper players to the table and facilitating, negotiating, or brokering solutions to public concerns (Denhardt & Denhardt, 1999). Disaster risk is increasingly recognized as a major development challenge (Hochrainer & Lorant, 2018). Recent calls emphasize the need to proactively engage in disaster risk reduction as well as to establish new partnerships between private and public sector entities to decrease current and future risks (Busch & Givens, 2013; Hochrainer-Stigler & Lorant, 2018). Partnership has led to a successful approach for implementing climate change adaptation (Crystal, Peterson, & Rochefort, 2013).

The various public, public-private, and civil society partnerships and collaborations in Panay Island helped augment the resources of the local governments in their disaster preparedness programs. A triple reward system takes place when all stakeholders achieve their goals while at the same time reduce the vulnerability of communities to natural disasters. It is theorized, as shown in Figure 6, that the severity of threats which tsunami and other earthquake hazards pose to underdeveloped and developing communities decreases as the number of alliances and cooperation with agencies, organizations, and groups increases.

Good governance reinforces management strategies of collaboration and partnership. It ensures mutual relationship between the project's benefactors and beneficiaries. In the case of Panay Island, collaborators were all involved in planning and carrying out earthquake countermeasures.

CONCLUSION AND RECOMMENDATIONS

Globally, it is recommended that other natural disaster-prone countries facing similar challenges adopt effective and efficient strategies in DRRM. Inadequacy in preparation should not be blamed to their

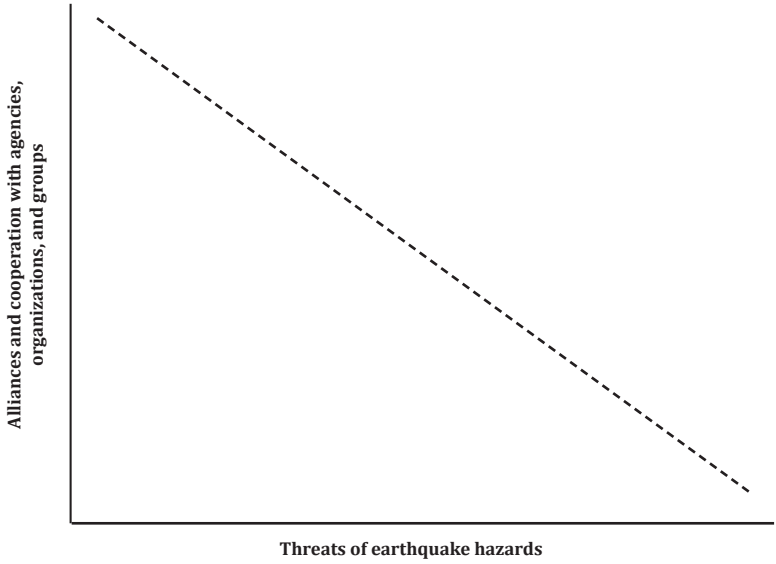

Figure 6. Effect of the level of alliances and cooperation with agencies, organizations, and groups on the threats of earthquake hazards

limited financial and technical resources. As shown in this study, the limitations of local governments can be addressed through successful collaboration and partnerships.

Locally, the conduct of quarterly or at least yearly earthquake drills in schools, offices, and hospitals should be sustained as prescribed in the Philippine Disaster Risk Reduction and Management Act of 2010 (RA 10121). Malls and grocery stores should be obliged to participate as these are the places where people usually congregate. It is better if all earthquake drills are conducted during the National Simultaneous Earthquake Drill so that responding personnel will know how to handle complex situations and mass casualties. Below are some specific recommendations drawn from the results of this study:

Organizational Recommendations

PHIVOLCS needs to hire additional resident seismologists to address issues on personnel complement in the three staff-controlled seismic stations in Panay Island. This will ensure efficiency in service delivery. It is also recommended that a merit-based promotion at least every five years must be put in place. This will motivate staff members to work harder, and, hence, contribute significantly to meeting

organizational goals. Professional growth leads to positive work attitude and zero turnover rate. Once neglected, junior and senior field observers may show persistent disobedience.

Technical Recommendations

There is a necessity to harness innovation and ensure sustainability in earthquake countermeasures. For instance, there might be some wisdom in investing on a technology to determine the preliminary epicenter and magnitude of an earthquake a minute after the event. This innovation will give people more time to evacuate before a tsunami hits their shoreline. It is also better to enhance the capability of the PHIVOLCS website so it does not slow down after a large earthquake strikes several provinces. The United States Geological Survey has this capability. Regular preventive maintenance of monitoring equipment will ensure that they are always functional. Countermeasures against vandalism are needed. A continuous expansion of the earthquake and tsunami network makes forecasting more accurate.

Practical Recommendations

While hazard mapping was conducted, it needs to be reinforced by massive community-based information, education, and communication activities. For instance, only a few villages vulnerable to tsunami had conducted tsunami drills during the implementation of the READY Project. Additionally, a documentation of DRRM procedures for each barangay is necessary so that there is continuity of observance to protocols even if there is a replacement of officials every three years. A pool of experts can do this task. An ISO 9001 certification for the document will make it acceptable nationwide.

Considering that one in every three Filipinos owns a mobile phone (Roa, 2012), government authorities can use it as a medium for disseminating information on tsunami and other earthquake hazards. The NDRRMC does this for typhoons. Likewise, the government needs to make its Project Disaster Information for Nationwide Awareness video material multilingual.

The most challenging part in applying hazard maps is their integration to zoning. Political will is required in convincing inhabitants to vacate their residential areas that are prone to tsunami. Relocation sites are needed too. The other option is to construct vertical structures in susceptible areas which will serve as evacuation areas minutes before the tsunami occurs.

Policy Recommendations

The following policy recommendations will further raise the level of preparedness in the country against destructive earthquakes. First, a law requiring all structures to be assessed by a group of independent structural engineers may help the government to identify buildings that require retrofitting. The provision of government subsidy to owners will motivate them to retrofit their structures. Second, business establishments including schools and hospitals must present proof of conducting an earthquake drill before their license to operate is renewed. Their certificate of participation in National Simultaneous Earthquake Drill needs to be validated. Third, a fund for an evacuation center per village is necessary. The facility must be located in a place safe from landslide, flood, storm surge, and tsunami. Its capacity should be based on the number of probable evacuees.

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