THE CURRENT CONTEXT OF MULTI-HAZARD EARLY WARNING SYSTEMS (MHEWS) FOR COASTAL RESILIENCE AT NATIONAL LEVEL:

PHILIPPINES

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1.0	25 September 2017	First draft presented at the Second Steering Committee
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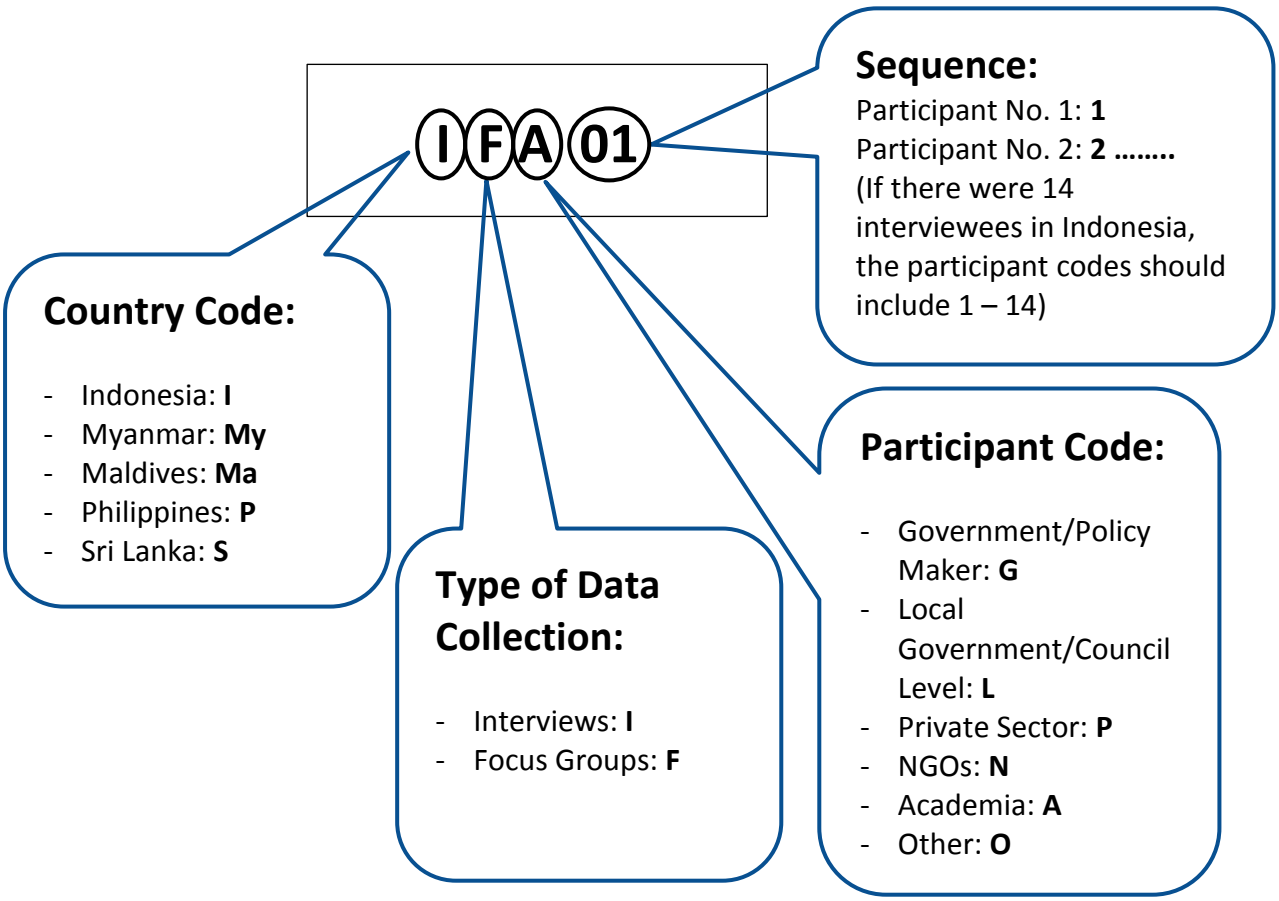
CODING LEGEND:

Interview respondents and participants in the focus group discussion are coded according to the following legend:



1. Executive Summary

Owing to its location and geography, the Philippines is exposed to a range of coastal hazards. Among these hazards, storms, floods, and landslides have wreaked the most havoc. Part of the country's response to this problem is to establish and strengthen its early warning systems (EWS). The persistence of disasters, however, signifies the need to re-evaluate and improve existing strategies.

Given that such trend is not unique to the Philippines, but common to most coastal cities in Asia, this project aims to build international and regional cooperation, particularly among HEIs, to improve EWS and increase coastal resilience in selected countries in Asia. As an initial step, this paper reviews the current state of EWS in the Philippines. In particular, it reviews and evaluates existing policies, initiatives, and actions on EWS and coastal resilience in the country. It also identifies key stakeholders and factors that strengthen EWS and contribute to coastal resilience. It likewise identifies the challenges associated with these initiatives and provides recommendations on how HEIs can address some of these challenges.

A combination of literature review, interview, and focus group discussions were conducted to collect the requisite information for this report. For the literature review, major online databases were used to search for relevant papers using a combination of the following keywords: early warning systems, coastal hazards, disaster risk management, disaster resilience, coastal resilience, and climate change. The results were then shortlisted and selected for relevance by comparing their abstracts or executive summary with the project's questionnaire. A total of 14 resource persons that are involved in or have worked extensively on early warning systems and disaster management were interviewed, while three people were invited to be part of a focus group discussion. Eight of them were from the academe, four were from the local government, and three were from the national government. There is also a representative each from an NGO and a multi-sectoral partnership. The private sector is not represented.

Based on the information collected, the research team has arrived at the following conclusions on the state of EWS for coastal hazards in the Philippines. There is no MHEW system dedicated for coastal hazards. There are, however, separate systems for different hazards, with more elaborate systems for hazards that frequently batter the country (i.e. typhoons, floods, and earthquakes) than other hazard types. Aside from limited attention paid to the latter hazard types, risk knowledge is also limited even for the more common hazards. This is because while risk and hazard assessments are generally available, there are minimal efforts to check their validity and utility. Moreover, most of these assessments are almost always carried out by technical agencies, without regard for how people construe risks and how other factors shape risk. Other elements of the EWS also exhibit this supply-side technocratic approach. For dissemination, for instance, failure to follow warnings is often framed as a communication and knowledge gap problem. Most agencies mandated to develop and disseminate warnings also exhibit little reflexivity especially in terms of the effectiveness of their approaches and strategy.

Also based on the information collected, the system and practice of EWS as well as efforts to build resilience have yet to catch up with policy declarations and frameworks. In general, while laws and plans already acknowledge the shift to multi-hazard and integrated assessments and on resilience, strategies remain largely reactive, with resources and actions directed mostly at relief and response, and key stakeholders, particularly those in the government, still operate in silos.

Generally, the gaps in the country's EWS for coastal hazards can be summarized and broadly grouped into two. The first issue is primarily procedural: the EWS is top-down, linear, and carried out in silos. Improving vertical and horizontal integration can enhance its effectiveness. The second issue is substantive: the scope, effectiveness, as well as the method for assessing the effectiveness of the current EWS (from risk knowledge to response capacity) is limited. They can be improved by expanding not just the scope, but also the criteria for what is considered valid and legitimate, particularly in the constructions of risk, role of EWS in mitigating such risk, and their link to resilience. Given these, HEIs can potentially fill these gaps by:

- Building strategic partnerships between HEI and the government in supplementing each other's research capacities, particularly in expanding the scope of hazard assessments and to evaluate the validity of these assessments.
- Advocating for enhanced knowledge mobilization and consumption of science. This needs to go beyond just the translation and dissemination of science but to enhance researches on how socio-economic and political factors filter and shape how policies and messages are acted upon.
- Expanding partnerships in addressing resilience to include NGOs and the private sector.
- Strengthening the coordination and collaboration across all scales and sectors. Engaging local communities as partners and co-producers of policies and plans and developing mechanisms that ensure that their inputs are also integrated at higher scales of decision-making are some of the possible ways forward.
- For education specifically, shifting the paradigm that education and awareness is about providing content and imparting skills, to cultivating a scientific mindset, such that people desire to and are able to seek for answers to questions and develop systemic solutions.

2. Introduction

CABARET aims to build capacity for international and regional cooperation between Higher Education Institutes (HEIs) in Asia (region 6) and Europe, and among Asian HEIs themselves, to improve Multi Hazard Early Warning (MHEW) and increase disaster resilience among coastal communities. In doing so, CABARET focuses on a subject area and a world region not sufficiently addressed by projects already being funded under previous schemes.

CABARET will address the cognitive and normative challenges in positioning early warning and preparedness in the wider trajectories of social change in societies and communities at risk. It is an imperative to take an integrated and holistic approach to early warnings for multiple hazards and risks tailored to user needs across sectors. In order to do this, first, partner institutions in each country will conduct a literature review at national level. The literature review mainly involves a review of current available policies, guidelines, national/local reports (e.g. White papers, if any), action plans, etc. to detail mainly the following:

- List of actions/initiatives, including, but not restricted to, policies, guidelines, national/local reports action plans, etc., for MHEW in coastal resilience taken at national/local level to improve MHEW and increase disaster resilience among coastal communities.
- Outcomes of the aforementioned actions/initiatives.
- Key stakeholders in MHEW in coastal resilience at national/local level in each country.
- Current enablers in MHEW in coastal resilience.
- Challenges associated with MHEW in coastal resilience.
- Role of the HEIs in the Country in improving MHEW in Coastal Resilience.

This report presents the current context of multi-hazard early warning systems for coastal resilience at the national level in the Philippines.

3. Methodology

For the literature review, we used online databases, JSTOR, EBSCO, and Google Scholar, to search for peer-reviewed articles, reports, and white papers on coastal hazards and early warning systems in the Philippines. We employed combinations of the following keywords: Philippines, early warning systems, coastal hazards, disaster risk management, disaster resilience, coastal resilience, and climate change. In instances where searches including 'coastal hazards' as keywords yielded limited results, we further specified the types of coastal hazards that are relevant to the country. We also downloaded regional, national, and subnational plans, sectoral reports, guidelines, and laws from government websites. These preliminary materials were further screened for relevance by comparing their abstracts and executive summaries with the project's questionnaire. We then closely examined and synthesized the shortlisted materials and according to the topics listed in the questionnaire. We likewise used the shortlisted materials as starting points for snowball sampling to find other relevant literature.

The research team conducted interviews and focus group discussions. For these interviews, we first compiled a list of possible resource persons from the government (national and local level representatives), academe, private sector, and civil society that are responsible for, or involved in hazard assessments, early warning systems, and disaster risk management of coastal areas in the country. We then sent letters requesting for an interview along with the questionnaire to the persons and offices in the list. There are 14 key informants who were interviewed and 3 who participated in an FGD. Table 1 lists these persons and the nature of their involvement in MHEW and coastal resilience in the Philippines. The interviews lasted for approximately 1.5 to 2 hours and were recorded using the Voice Memos application for iOS or an audio recorder. We then transcribed these recordings manually. The transcribed data were then analysed thematically.

Table 1: Participant Details

Participant Code	**Level of experience in terms of involvement in MHEW in Coastal Resilience**	**Any other Remarks**
PFA01	She obtained her Doctor of Engineering degree on Mechanical and Environmental Informatics from the Tokyo Institute of Technology where she conducted a doctoral research on socio-environmental informatics for coastal ecosystem monitoring and management. Her wide range of topic lectured and research conducted includes: surveying and mapping, GIS for various applications, environment, urban and regional planning, ecology, disaster management and transportation	
PFA02	He is an Associate Professor at the Physics Department of one private university. He is currently the President of RESearchers for Clean Air Inc. (RESCueAIR).	

Participant Code	Level of experience in terms of involvement in MHEW in Coastal Resilience	Any other Remarks
PFL03	He is a Disaster Risk Reduction Management Officer IV of City of Sta. Rosa, Laguna	
PIA04	He has worked extensively in the area of MHEW in coastal resilience for the past 10 years.	*"The organisation he works for at the moment is one of the main NGOs in the country that work to help victims of Coastal Hazards."*
PIG05	He is the Head of Institutional Partnership Unit of the Local Government Academy of DILG	*"The LGA is the premier training and development institution for capacity building towards innovative and effective local governance."* http://lga.gov.ph/mission-vision
PIA06	He is the Center Director of Br. Alfred Shields FSC Ocean Research Center (ShORE) of the De La Salle University	*"The SHORE Center supports the Vision-Mission of the University by providing significant learning activities to enable faculty and students to generate knowledge and technologies that will foster good stewardship of the seas and coastlines, and lay the groundwork for community development, and social transformation, particularly among the youth and disadvantaged members of the coastal communities."* http://www.dlsu.edu.ph/research/centers/shore/
PIA07	He obtained his PhD in Engineering (Coastal Engineering) from Kagoshima University, Japan. He finished Master of Engineering degree Specializing in Environmental Science and Technology from UNESCO-IHE in Delft, the Netherlands. He has been involved in an international Joint Research and Field Survey on Storm Surge (Typhoon Haiyan 2013) in collaboration with universities and institutes in Japan and Vietnam.	
PIL08	He is the Disaster Risk Reduction Management Officer of City of Malabon	

Participant Code	Level of experience in terms of involvement in MHEW in Coastal Resilience	Any other Remarks
PIL09	He is the Disaster Risk Reduction Management Officer of City of Biñan, Laguna	
PIL10	He is the Disaster Risk Reduction Management Officer of City of Navotas	
PIG11	Representatives (Senior Economic Development Staff and Regional Development Staffs) of the National Economic and Development Authority	*"The National Economic and Development Authority (NEDA) is the country's premier socioeconomic planning body, highly regarded as the authority in macroeconomic forecasting and policy analysis and research."* http://www.neda.gov.ph/about-neda/
PIN12	Representatives (Program Associate of Projects and Partnerships Program, and Senior Research Associate, Research Knowledge and Exchange Management Program) of the Center of Disaster Preparedness	*"The Center for Disaster Preparedness (CDP) is a regional resource center based in the Philippines that endeavors to promote Community-Based Climate and Disaster Risk Reduction and Management (CB CDRRM), facilitate interactive learning and discourse on climate and disaster risk reduction, and advocate for policies and programs that protect the environment and mitigate climate and disaster risk."* https://www.cdp.org.ph/what-we-do
PIA13	She is a physical oceanographer and Professor at the University of the Philippines Marine Science Institute. She is the Chair of the Commission of Higher Education Technical Committee on Marine Science, and a member of the CHED Technical Panel on Science and Math. She is also a member of the National Panel of Technical Experts for the Climate Change Commission. She has received the National Academy of S&T Outstanding Young Scientists (OYS) Award, and the Outstanding Women in the Nation's Service (TOWNS) Award.	

Participant Code	Level of experience in terms of involvement in MHEW in Coastal Resilience	Any other Remarks
PIG14	He is the head of the Philippine Institute of Volcanology and Seismology (PHIVOLCS)	*"PHIVOLCS is a service institute of the Department of Science and Technology (DOST) that is principally mandated to mitigate disasters that may arise from volcanic eruptions, earthquakes, tsunami and other related geotectonic phenomena."* http://www.phivolcs.dost.gov.ph/index.php?option=com_content&view=article&id=13&Itemid=300075
PIA15	She is a researcher and an assistant professor at the Communication department of one of the Ateneo de Manila University. Her expertise is in science and risk communication. She is leading a projects analysing people's reception and understanding of scientific information during flood events, and examining science and risk communication issues in areas affected by Typhoon Haiyan.	
PIA16	She is a professor at the Dept. of Sociology and Anthropology of the Ateneo de Manila Univeresity with a long history of research in social vulnerability and resilience. She is the co-lead of the Philippine team of the Coastal Cities at Risk project funded by IDRC, and is the co-director of the Master of Disaster Risk and Resilience program of the university. She is currently co-proponent of a project involving areas affected by Typhoon Haiyan.	
PIO17	She is the former co-lead of the Philippine team of the Coastal Cities at Risk project, and the former Executive Director of the Manila Observatory, a Jesuit non-government, non-profit research center that has conducted extensive research on hazards and risk. She was recently elected president of the National Resilience Council, an inter-sectoral (government, non-government, private) partnership aiming to build resilience in cities.	

Participant Code	Level of experience in terms of involvement in MHEW in Coastal Resilience	Any other Remarks
PIG18	He is from the Post-Disaster Evaluation and Management Division (PDEMD), Rehabilitation and Recovery Management Service (RRMS), Office of Civil Defense (OCD). The OCD is the implementing arm of the National Disaster Risk Reduction and Management Council (NDRRMC).	

4. Background

The Philippines is an archipelagic country consisting of 7,107 islands. These islands are divided into three main groups, namely: Luzon, Visayas and Mindanao. The country's capital, Metro Manila, is found in Luzon and consists of 16 cities and 1 municipality. The population of the country is 100.9 million with an annual per capita income of $2,872.50. The country's recorded gross domestic product in the second quarter of 2017 was 3,944,292 million pesos (Philippine Statistics Authority, 2017).

The main businesses and industries of the country are wholesale and retail trade followed by accommodation and food service activities, and manufacturing. Agriculture, forestry and fishing are ranked below the top ten. Electronic products are the country's top exports and imports (Philippine Statistics Authority, 2017). As of July 2017, employment rate is at 94.4% while underemployment and unemployment are 16.3 and 5.6%, respectively. Employment in the services sector is 55.6% and the agriculture and industry employment are 25.2 and 19.2%, respectively (Philippine Statistics Authority, 2017).

The Philippines has a literacy rate (basic reading and writing skills) of 96.5%. Many students enroll in elementary public schools (11,151,040 enrolments in school year 2015-2016) but most of them fail to finish the secondary education (2,280 enrollments for Grade 12 in school year 2015-2016). According to the Philippine Statistics Authority in 2015, the poverty incidence among population was 21.6% (UN Office for the Coordination of Humanitarian Affairs, 2017).

The Philippine archipelago is located on the Pacific Ring of Fire and its proximity to the equator makes it vulnerable to natural hazards, such as earthquakes, volcanic eruptions, typhoons, floods and droughts. According to the Office of Civil Defense/National Disaster Risk Reduction and Management Council, in 2016 alone, 83 natural disaster incidents with 12,300 affected population were recorded (UN Office for the Coordination of Humanitarian Affairs, 2017).

The Philippines, with its long coastlines (Government of the Philippines, 1999) is reliant on its coastal resources. Households in coastal areas are engaged in various coastal activities (Department of Environment and Natural Resources, 2001) for livelihood and food security. In the Central Visayas, for instance, majority of the Filipinos get animal protein from fish. Majority of its residents are dependent on their coral reef ecosystems as their source of livelihood (Green et al., 2004).

Given the Philippine context of being hazard-prone coupled with the importance of coastal resources, efforts to improve Multi Hazard Early Warning System (MHEWS) and build resilience in coastal communities could potentially contribute greatly towards sustainable development. The present study examines how this can be achieved through international and regional cooperation between Higher Education Institutes (HEIs) in Asia and Europe, and among Asian HEIs themselves.

5. Coastal Hazards

The Philippines, as an archipelagic country located in the Pacific typhoon belt and Pacific ring of fire countries is exposed to the complete gamut of coastal hazards (ADPC, 2007). The combination of extensive coastlines, which span a total 36,289 kilometres, frequent typhoons, and high seismicity, mean that 62% of its territory and 73% of its population experience more than one hazard (NDCC, 2009). During the twentieth century, the Philippines was recognized for its high number of recorded cases of disasters. In fact, it was identified as one of the world's most disaster prone countries (Bankoff, 2003).

The constant and frequent threats of natural hazards in the Philippines have become an integrated part of the history and everyday life of the Filipinos (Bankoff, 2003). Correspondingly, the Philippine coastlines' experience of sea-level rise and extreme climate events (Capili, Ibay, and Villarin, 2005) have also given rise to a consciousness about coastline hazards.

Table 2 shows all hazard occurrences that happened in the country and resulted into disasters since 1950. The Centre for Research on the Epidemiology of Disasters (CRED) classifies events as disasters when any of the following conditions are met: 10 or more people are dead, 100 or more people are affected, a state of emergency is declared, or international assistance is requested (Keller & DeVecchio, 2015). Note, however, that it includes hazard occurrences that are not explicitly coastal because available data is not sufficiently disaggregated. For example, some records of flood incidences do not distinguish whether these occurred in coastal, riverine, or upland locations.

In the past two decades, storms (tropical cyclones over the Pacific Ocean) and floods constitute the bulk of disaster incidences in the country, accounting for half and a third of the total, respectively. These hazards likewise wreaked the most havoc to people and property. Compared to other types of hazards, storms are also, by far, the deadliest weather occurrence, followed by landslides and floods (Figure 1). In terms of the ten most extreme disasters that occurred in the country since 1900, five of these disasters are most lethal, eight affected the most number of people, and seven (7) incurred the most economic losses occurred in the past two decades. More than half of these extreme weather events are also associated with storms (CRED EM-DAT, n.d.).

The Philippines' hydro-meteorological agency, Philippine Atmospheric, Geophysical and Astronomical Services Administration (PAGASA), analyzed tropical cyclones passing through the Philippine Area of Responsibility (PAR) from 1971 to 2013, and found a slight increase in the number of events occurring during El Niño periods with intensity corresponding to the typhoon category (maximum sustained winds of 150kph or greater) (PAGASA, 2011; PAGASA & OML, 2015).

The Philippines will likely experience an increase in summer precipitations and precipitation events and winds that are linked to cyclones (Christensen et al., 2007). The regional analysis of wind speed in the South East Asia (SEA) suggests an increasing intensity of storm events. Between 1960 and 2000, the wind speed rose from its normal levels (Rozynski, Hung, and

Ostrowski, 2009) and by the year 2100, sea levels in SEA were estimated to rise by 40cm (Yusuf, and Francisco, 2009). Along the Philippine coast, in particular, there will likewise be an expected residual rise in its coastline (Hulme, and Sheard, 1999 as cited in Combest-Friedman, Christie, and Miles, 2012). In the context of imminent storm variability, sea-level rise, and changes in the shoreline, coastal flooding caused by tropical cyclones will likely bring adverse consequences to coastal ecosystems and communities (Woodruff, Irish, and Camargo, 2013).

Table 2. Number of disasters and disaster impacts in the Philippines, by decade (Data compiled from CRED Emergency Events Database)

Year	Occurrences	Deaths	People Affected	Damage cost ('000 U$, constant 2010)
1950-1959	15	3,214	62,553	50,000
1960-1969	25	2,618	2,313,935	132,100
1970-1979	75	13,229	15,515,612	1,154,431
1980-1989	87	8,362	26,051,278	1,640,830
1990-1999	116	14,574	38,320,295	3,280,608
2000-2009	145	9,418	47,873,355	2,208,034
2010-2017	131	13,913	79,943,561	17,726,546

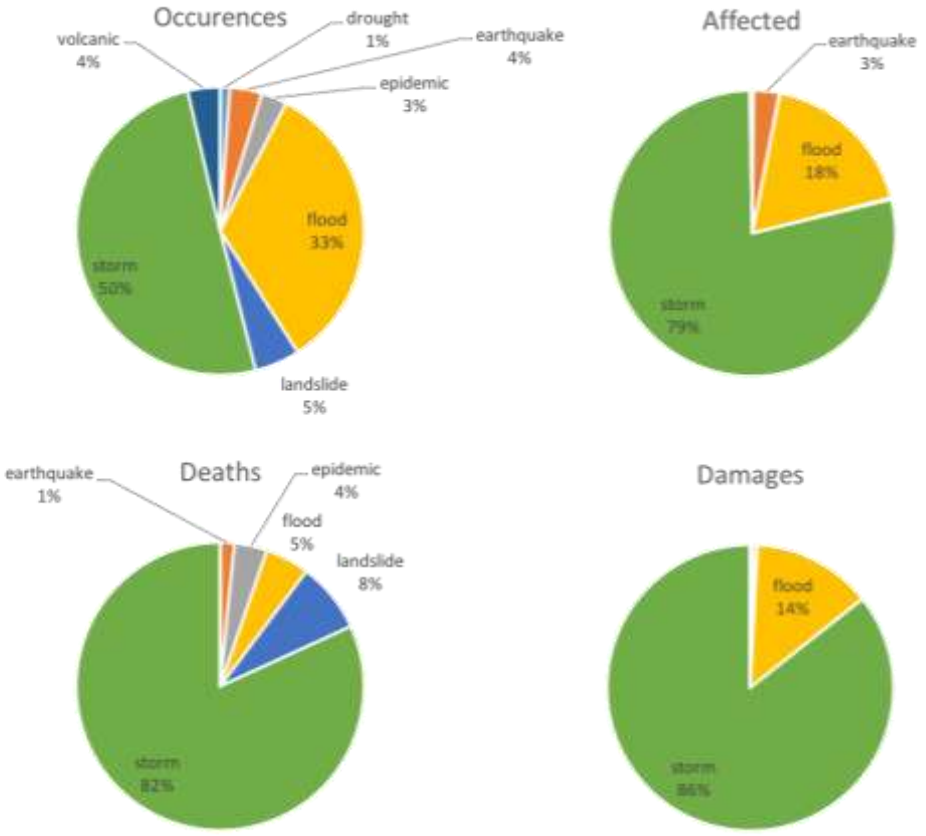


Figure 1: Relative share of disaster occurrences and disaster impacts by hazard type from 2000 to 2017 (Data compiled from CRED Emergency Events Database)

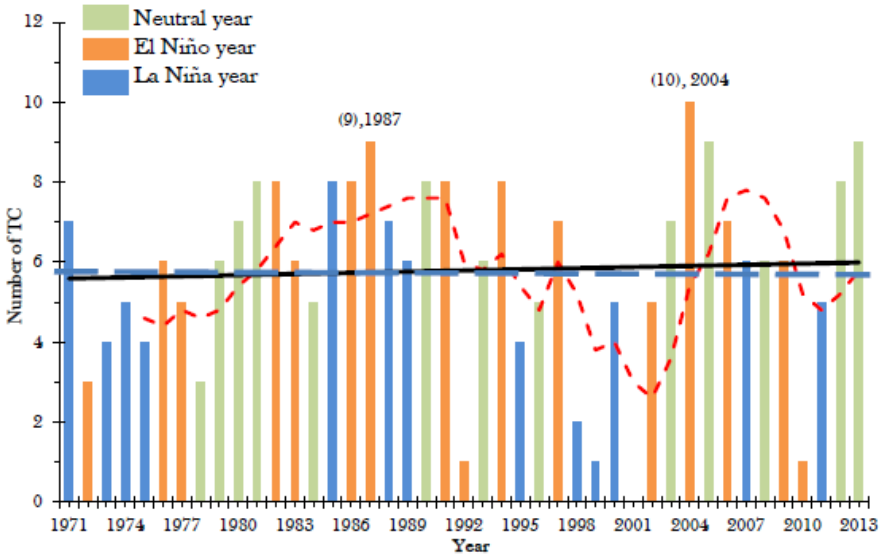


Figure 2: Number of extreme tropical cyclones (wind speed of 150 kph and above) entering PAR from 1971-2013. The red dashed line shows five-year running mean; the black line shows the linear trend; the blue dashed line is the annual average (5.8) (Taken from PAGASA & OML, 2015).

5.1 Impact of the Coastal Hazards

5.1.1 Literature Review findings

The most documented impacts of coastal hazards are displacement, injuries, and losses of lives and properties. In the recent decades, these hazards cause more 500 deaths and cost Php20 billion in damages, or about 0.5% of the country's GDP, annually (NDCC, 2009). The most notable recent catastrophe in the country occurred on November 8, 2013. With a maximum sustained winds of 235 kilometres per hour (kph), gustiness of up to 275 kph, and surges of up to 7 meters, Typhoon Haiyan is the most devastating storm to hit the country to date (Jibiki, et al., 2016). It caused 6,300 deaths, 28,688 injuries, and affected 16,078,181 people. It also incurred Php93 billion in damages to infrastructure and productive sectors (NDRRMC, 2013).

Albeit less prominent, there are also other impacts that may not immediately result to disasters but contribute to the erosion of resilience and increase disaster risks in the long-run. Examples include the degradation of the country's marine ecosystems (Nicholls, et al., 1999) and the shift of some communities from subsistence farming in river deltas to cash aquaculture (Dalisay, 2008) as consequences of saltwater intrusion. The latter practice also has cultural implications as rituals and traditions associated with rice farming have vanished (Dalisay, 2008). While equally important, literature, however, on these gradual and less tangible effects of coastal hazards are limited.

5.1.2 Interview and Focus group findings

Coastal areas are defined base on the standard set by the Land Ocean Interaction for the Coastal Zone Project of the International Geosphere-Biosphere Programme (PIA13), which considers areas with up to 200m elevation and up to 200m deep. Given this data almost the entire Philippines, with the exception of mountain ranges, is categorized as coastal. Exposure of communities to coastal hazards is high given the archipelagic nature of the country. While there are prevailing laws on easements (Water Code 1067), these date back to Spanish time and do not consider the effects of elevation (PIA13). Thus, enhancements to the process of Comprehensive Land Use Planning (CLUP) at local government levels reveal attempts to incorporate elevation effects to these guidelines but are currently recommendatory in status rather than required (PIA13).

According to PIA13, coastal hazards in the Philippines can be categorized according to these broad types:

Physical – tsunami, storm surges, floods (which are the focus of most early warning systems), Soil Liquefication (PFL03)

Biological – fish kills, harmful algal blooms

Human-made – oil spills, grounding of ships, human waste (PFL03)

Among these different categories, the physical hazards seem to be the most common type that the respondents are aware of. PIG18, for example, cited coastal erosion, tsunami, storm surge, ocean swells, and sea level rise, which all fall under physical hazards.

Impacts from these coastal hazards range from losses in infrastructure and human lives, habitat/ecosystem destruction (marine biodiversity, eutrophication, destruction of coral reefs, trawling of foreign commercial fishing vessels), decline in fish catch/aquaculture, and livelihood insecurity (PIN12). PIG18 further states that these impacts can, in turn, affect the local, regional, and national economy.

According to PIN12, coastal communities identified the hazards of biggest concern based on experience and exposure. The most common are floods (due to rain/typhoons, earthquake-induced, or due to changes in elevation), storm surge, landslides, sea level rise, coastal erosion and coastal flooding due to rise in tide (PIN12, PIG14).

"The Philippines is prone to tropical cyclones that generate storm surges and large magnitude earthquakes that generate tsunamis. These have caused significant loss of lives, damage to properties and impact to economy. The latest examples would be the 2013 Super Typhoon Haiyan which caused storm surges in the eastern coasts of Eastern Visayas and the 1976 Moro Gulf Tsunami, both of which caused more than 6,000 deaths (PIG14)"

All key informants and FGD participants agree that it is relevant and high time that these hazards are addressed and prioritized both at the national and local levels.

5.2 Early Warning Systems available for Coastal Hazards

5.2.1 Literature Review findings

Early warning systems (EWSs) are "extensive systems that integrate different components of disaster risk reduction for the provision of timely warnings to minimize loss of life and to reduce economic and social impact on vulnerable populations (Garcia and Fearnley, 2012, p. 1)." The UNISDR (2006) identifies four elements of early warning systems (EWS). The availability of EWS in for coastal hazards in the country is assessed according to these elements. In general, there is no EWS dedicated solely for coastal hazards, but there are systems that cover a number of these hazards.

Risk Knowledge

- Assessing risks and generating risks maps are primarily the responsibility of local governments as part of their comprehensive land-use plans (see Republic Act 7160). However, aside from the limited capacity of most local governments to prepare, update, and implement the CLUP (Salazar-Quitalig & Orale, 2016; Corpuz, 2013), risk assessments within the CLUP are likely limited because the guidelines for hazard assessment, for instance, only cover rapid-onset hydro meteorological and geophysical events (see HLURB, 2014).
- The National Risk Reduction and Disaster Management Council (NDRRMC) also conducts pre-disaster risk assessments to inform emergency response (OCD, 2015). The nature of these assessments, therefore, are not for long-term planning but a response to an impending and potentially threatening hazard event.
- The Philippine government also the implemented Project National Operational Assessment of Hazards (NOAH) in 2012. The project, to date, generated nationwide storm surge and landslide maps, and flood maps of the country's major river basins. It likewise created exposure maps of critical infrastructure to the aforementioned hazards (see http://center.noah.up.edu.ph/).
- Other national government agencies also conducted hazard assessments and mapping. The Mines and Geosciences Bureau (MGB) has nationwide flood and landslide maps, while the the Philippine Atmospheric Geophysical and Astronomical Services Administration (PAGASA) and the Philippine Institute of Volcanology and Seismology (PHIVOLCS) has generated flood and geohazard maps, respectively.

Monitoring and forecasting

- The country has the capacity to monitor and forecast hydro meteorological hazards through PAGASA and geophysical hazards through PHIVOLCS and the MGB. It also has the capacity to monitor harmful algal blooms through the Bureau of Fisheries and Aquatic Resources (BFAR).
- The Philippines is also part of Sentinel Asia (SA), an initiative organized by the Asia-Pacific Regional Space Agency Forum (APRSAF) in November 2004 as a collective response to the documented number of large-scale disasters in Asia over the past

decades (Kaku and Held, 2013). This initiative facilitates the sharing of data from participating satellites for emergency observations. Philippine organizations involved in Sentinel Asia activities include: The National Disaster Risk Reduction and Management Council (NDRRMC), Office of Civil Defense (OCD), National Mapping and Resource Information Authority (NAMRIA), Bureau of Soils and Water Management (BSWM), Mines and Geosciences Bureau (MGB), Philippine Atmospheric, Geophysical and Astronomical Services Administration (PAGASA), Philippine Council for Industry, Energy and Emerging Technology Research and Development (PCIEERD), Philippine Institute of Volcanology and Seismology (PHIVOLCS), Manila Observatory, and National Institute of Geological Sciences, University of the Philippines (NIGS) (Kaku and Held, 2013).

Dissemination and communication

- The agencies responsible for monitoring and forecasting hazards issue warnings to people at risk primarily through traditional (i.e. television and radio) and new (i.e. government websites, Twitter, and Facebook) media. Advisories cover hazard characteristics and potential impacts.
- Monitoring agencies also relay the warnings to the NDRRMC, which, depending on the hazard magnitude, then activates the emergency responders at the national-level and the local DRRMCs. The local DRRMCs, particularly the Barangay DRRMCs, are responsible for relaying the warning information to their communities (NDRRMC , 2014).
- Project NOAH also publishes weather forecasts and near-real information from rain, stream, and tide gauges in its website.
- These stakeholders also conduct information and education campaign to local governments and communities to increase hazard and risk awareness (CCC, 2010)

Response capability

- At the institutional level, the NDRRMC has an operations manual for disaster response that it follows after receipt of hazard advisories from the monitoring agencies (NDCC, 2009). While local governments are mandated to create a preparedness and risk reduction plan, which should also include a response plan, most DRRMCs are not operational (IRIDeS, 2014).
- From the perspective of the people at risk, the more immediate warning advisories and response plans, as well as the longer term risk reduction plans hardly reflect complex social concerns. In the case of Haiyan, for instance, despite accurate forecasts and timely warnings, thousands of people still died. Reasons cited for this range from not understanding the warning, underestimating hazard magnitude, to unsuitable evacuation centres (Jibiki, et al., 2016; Lagmay, et al., 2015; IRIDeS, 2014). In addition, while the Leyte and Eastern Samar, Philippines had community preparedness and mitigation and prevention strategies, which include early warning systems utilizing hazard maps and flood drills, and communication centers, they were still severely affected by Typhoon Haiyan because preparations were limited for flooding from upland and river areas. These areas failed to prepare for flooding

caused by a storm (Esteban et al., 2015). Moreover, after the disaster, houses are still being rebuilt next to the coastline despite government declarations to strictly enforce no-build zones (Esteban, et al., 2015).

In summary, risk knowledge in the country is limited. This is because local governments, despite being mandated to include risk assessments in their land use and development plans, have limited capacity to carry them out. Moreover, the guidelines for preparing these plans only cover rapid onset hazards. Existing efforts of the national government (through agencies or projects) to map, assess, forecast, and monitor hazards also reflect the predilection for rapid-onset types as they only cover tropical cyclones, rainfall-induced flooding, storm surges, earthquakes, tsunamis, rainfall-and-earthquake-induced landslides, and harmful algal blooms. In assessing hydro meteorological and geophysical hazards, in particular, institutional fragmentation have resulted in considerable overlaps and duplication efforts. Literature that evaluates the adequacy and, more importantly, the utility of these knowledge products in informing disaster response and risk reduction plans are scant. In general dissemination and communication of these products have taken a supply-side, knowledge-prescriptive approach whereby monitoring agencies and other stakeholders aim to provide and educate people of the hazards they face. Institutional responses to hazard and risk knowledge, in both the short and long-run, also largely ignore the socio-cultural and economic realities of the people at risk. As an example, in the single-minded focus to keep people away from hazards, most evacuation plans ignore risk perceptions and the heterogeneity of risk tolerances. No-build zones likewise disregard the broader decision space where the desire to be safe from hazards is only one among other competing needs and priorities.

5.2.2 Interview and Focus group findings

PIA13 evaluates the available Early Warning Systems based on the 3 categories of hazards:

1. For physical hazards, early warning systems are implemented by agencies of the Department of Science and Technology. Monitoring of tropical cyclones and storm surge early warning is provided by the Philippine Atmospheric Geophysical and Astronomical Services Administration (PAGASA). Tsunami warning are provided by the Philippine Institute of Volcanology and Seismology (PHIVOLCS), *"using its national seismic monitoring network of 95 stations, sea level monitoring network of at least 23 stations, and community tsunami early warning systems for 10 areas with seal level detection and warning stations (PIG14)."*

   The infrastructure for detecting some of these hazards, however, are inadequate. The coverage of high-frequency Doppler radars and meteorological marine bouys, for instance, are limited (PIG18). Moreover, the translation of these warnings to actions on the ground needs to be improved. Heads of government units are still tasked with deciding on appropriate responses, which sometimes becomes ad hoc rather than being guided by clear protocols (PIA13).

2. Early warning systems for biological hazards are more challenging. The Bureau of Fisheries and Aquatic Resources (BFAR) is capable of monitoring and detecting harmful algal blooms but there are too many incidences of algal blooms throughout the country, which overwhelm the current capacity of BFAR. Coverage and frequency of monitoring are key constraints which can be augmented by remote sensing. Raising warnings and disseminating them to communities in a timely manner are also concerns because data has yet to go through BFAR and the Department of Health (DOH). Main to this concern is BFAR's apprehension about making data readily accessible because they do not want to create panic. Some LGUs resorted to devising their own low-tech monitoring systems (e.g. feeding the shellfish to the chicken and observe how they react) as an alternative in verifying said biological hazard.

   For hazards presented by coral bleaching, the Marine Science Institute (MSI) has developed an index to measure severity but lack of funding has constrained efforts along this line.

3. For anthropogenic hazards, early warning system are limited, mainly due to the accidental nature of this incidences (e.g. ship grounding that destroys coral reefs). Pre-hazard assessments are needed to facilitate post-hazard compensation (e.g. for fishermen and lost economic opportunities due to reef destruction). Unfortunately, local economic valuations of reefs are lacking; through there are international estimates, they tend to undervalue the reefs.

In the case of physical hazards, specifically, it should be clarified that there is not one single or unified system for assessing multiple hazards (PIN12) – different coastal hazards are assessed separately. PIN12 would argue that this approach is more sensible since the nature of different hazards requires different approaches to EWS. Based on their experience with communities, only the flood and typhoon EWS are consistently made available from PAGASA. Materials developed by Project NOAH (National Operational Assessment of Hazards) are available online but some LGUs have limited access to the internet and rarely use these materials in barangay planning. Technical terms like "storm surge" are also not well understood by everyone, highlighting the need to localize and contextualize EWS and hazard assessment materials.

Communities have also devised their own EWS such as the use flood markers and systems of bells for issuing warnings. There have been attempts to make these initiatives more inclusive, such as the use of flags to cater to the deaf; however, these are limited. Some communities have rain gauges installed though not all communities are able to fully use them. The more proactive councils conduct house-to-house visits to spread the word (e.g. warnings, evacuation notices). As a result, EWS are not standardized across communities and information dissemination within communities is also uneven.

In addition, there may be a need to clarify the sharing of resources and responsibility for implementing early warning systems at the local level. According to PIL09, local government units consider early warning system as responsibility of the *barangay* officials (barangay is

the smallest political unit in the Philippines). Barangay initiatives include use of a text blast to relay early warning messages, although it is not clear, by law, if this is an allowable expense. The City DRRMC may also utilize members of the Barangay Disaster Committee to patrol villages with a microphone (or mega phone). Barangay members and concerned citizens may also conduct observations themselves, as in the case of the City of Marikina which uses a simple system of post markings to determine river water levels with corresponding warnings for evacuation given depending on the present water level.

In many cases, the directives disseminated at the city or barangay level are for evacuation, which is another major concern. Unfortunately, according to PIN12, evacuation centres do not adhere to international standards. LGUs rarely have lists on assembly areas and routes, and rarely also have pre-assigned lists of who to accommodate and where. Schools and covered courts are often used as evacuation centres with little consideration for safety and accessibility. Inclusivity is again an issue – informal settlers are left out as they are unregistered voters.

6. Multi Hazard Assessments

6.1.1 Literature Review findings

A number of national government agencies assess different types of hazards as part of their mandate. PAGASA assesses hydro-meteorological hazards (PD 1149), PHIVOLCS and to, some extent (EO 128), MGB for geophysical hazards (EO 192), and BFAR, through its red tide monitoring program, for harmful algal blooms. With the exception of BFAR, these agencies have created maps for each type of hazards. The resolutions of these maps, however, are still coarse with a scale of 1: 10,000, which limits its potential use to DRR planning.

Partly as a response to the institutional fragmentation of hazard assessments, particularly for the common hazard types, namely, flood and landslides, the Philippine government instituted Project NOAH in 2012 (Lagmay, et al., 2017). This initiative aims to undertake disaster science research development, advance the use of cutting edge technologies, and promote innovative information services for government's disaster prevention and mitigation efforts (Lagmay, et al., 2017). The project installed sensors and radar systems, to improve the country's capacity to monitor precursor events to floods and landslides. Automated Weather Stations (AWSs) and Automated Rain Gauges (ARGs) were locally assembled and deployed. The said weather and water-level sensors complemented the weather monitoring of the Philippine Atmospheric Geophysical and Astronomical Services Administration's (PAGASA). At present, the DOST Advanced Science and Technology Institute has 81 AWSs and 872 ARGs deployed across the country (DOST-ASTI, 2011 as cited in Lagmay et al, 2017). Landslide monitoring systems drawing from the work of Catane et al. (2011) were deployed in Benguet and St. Bernard, Leyte.

Project NOAH has also generated maps floods, storm surge, and landslide maps with finer resolutions. At the coastal areas, specifically, the hydrologic and hydraulic modeling platforms were used to simulate coastal flooding caused by storm surges (Lagmay, et al., 2017). LIDAR and slope stability models were for landslide zonation maps (Rabona et al. 2015 as cited in Lagmay et al., 2017).

Despite the Project NOAH's intent to inform DRR planning, it is difficult to ascertain at this point how it feeds into planning as NDRRMC's Operations Manual for Response (2015) and the Guidelines for Comprehensive Land Use Planning (2014) make no mention of the project's outputs.

The apparent focus of existing efforts on floods, landslides, storm surges, and earthquakes is understandable because these hazards are the most common drivers of disasters in the country. It is, however, problematic for two reasons. First, the neglect of other hazard types (e.g. slow-onset and potentially irreversible sea level rise) means that the country and communities are unaware and, consequently, cannot adequately prepare for the range of hazards they are exposed to. Second, the current approach of assessing hazards in isolation and, at best, generating composites of these hazards, means that interactions among different hazards as well as with human activities that influence how hazards are manifested

are not accounted for. Flood maps, for instance, do not include the effects of eustatic sea level rise and overdrawing of groundwater resources in coastal areas. Regular updating is also not built into existing assessment efforts, which limits our understanding of how hazards change over time.

6.1.2 Interview and Focus group findings

The Philippines has conducted assessment for multiple physical hazards but the responsibilities are distributed among different agencies: floods and typhoons (by PAGASA and Project NOAH), earthquakes and tsunami (by the Philippine Institute for Volcanology and Seismology – PHIVOLCS). However, these are mostly at the scale of kilometers, and few with finer resolution (PIA13). The Philippines' first micro-satellite project, Diwata, is trying to address this but coverage is limited. The coarseness of these assessments results in limited use for planning because the country's terrain is very heterogeneous. Ideally, resolution should be in the realm of 0.5km, which the Philippine LIDAR (Light Detection and Ranging) project is trying to address (PIA13). Good local maps (city/municipal-level) are available for some areas, but mostly areas of interest (e.g. mariculture, ports, protected areas).

Other agencies involved in hazard assessment are BFAR (for biological hazards) and the National Mapping and Resource Information Agency (NAMRIA) (e.g. for elevation mapping), local and national academic institutions (PIA13). Unfortunately, there is a lack of data-sharing even among government agencies. NAMRIA, PHIVOLCS, PAGASA, and MGB are all part of the Collective Strengthening on Community Awareness and Natural Disasters (CSCAND) (PIG18), which could potentially address concerns on data-sharing and integration. The activities and the nature of CSCAND, however, are currently difficult to ascertain.

Hazard assessments are also often done as separate assessments of each hazard, rather than as an assessment of cascading or concatenated hazards (e.g. an earthquake that triggers a tsunami that creates flooding; coastal erosion impacts on storm surge). In addition, with regards to the anthropogenic / human-made hazards, according to PIA13, we currently do not have models, for example, to determine the spread of oil after a spill or to assess seasonal sea lanes for mitigating human-made hazards. Additional capacity for marine and coastal concerns, specifically, also needs to be developed because these are not much of a priority relative to terrestrial concerns (PIA13). For example, within the Dept. of Environmental and Natural Resources (DENR), about 90% of its personnel are dedicated to terrestrial concerns. This could be due to costs because doing marine research is more expensive. The country only has 20+ oceanographers, which is a low number given its archipelagic nature (PIA13).

Thus, the country has the capacity to conduct physical hazard assessments at the national level, but: (1) expertise lies mostly in assessing rapid-onset natural hazards; (2) hazard assessment should be broadened to include biological/ecological and man-made coastal hazards; (3) efforts need to be harmonized across the different national agencies involved; (4) an efficient system of data-sharing and coordination must be developed. It is interesting to note that despite affirming the country's capacity to conduct hazard assessments, PIG18

claims that the country is incapable of providing trainings or consultancies to other countries without proffering reasons why.

Particular effort then needs to be focused towards cascading initiatives to and building capacities at the local level. For example, skills in Geographic Information Systems (GIS) are crucial (PFA01, PFA02, PFL03) for mapping hazards and conducting analyses in relation to exposure and vulnerability indicators, and emergency transport and evacuation routes, for example. However, not all LGUs have GIS expertise, relevant spatial data is incomplete or not made accessible, and there is no clear person or system within the organizational structure of the LGU to manage GIS information and resources. LGU representatives contend that much of the training has been focused more on compliance issues for disaster risk reduction and/or climate change adaptation related policies (PFA01, PFA02) rather than the development of needed skills. According to PIN12, the information from PAGASA and PHIVOLCS are found by communities to be “too technical” or “intimidating”. Some technologies and assessments have limited use because they either fail to reach communities or fail to consider ability of communities to make use of these techs and assessments. Moreover, capacities need to be built in local government and boundary organizations that would be responsible for translating results to policy then policy to implementation.

Lastly, vertical coordination between national and local governments also needs to be improved, particularly for validation of hazard assessments. For example, rainfall measurements using the Doppler technique rely on having calibrated working sensors, which is not always the case (PFL03). Tarpaulin hazard maps disseminated from Project NOAH to a certain LGU in Samar province had incorrect locations and neighborhoods, and no ground-truthing of alleged hazard areas; hence, they were not usable and useful to the LGU (PIA15). Thus, it is crucial for technologies and assessments conducted at the national level to be complemented with validation by the people in local communities in order to better provide useful MHEWs and build resilience in general (PFA02, PFL03, PIA15).

7. Global Initiatives on Multi Hazard Early Warning (MHEW) Systems

7.1.1 Literature Review findings

The post-2015 global frameworks were not built from scratch. Rather, they are continuations of existing agendas that date as far back as the 1980s. For this reason, the Philippines already has institutions and mechanisms in place to implement them. In some instances, existing national frameworks, plans, and targets predate the global post-2015 frameworks. While progress in achieving the new targets are difficult to ascertain because they are fairly recent, there are numerous efforts to incorporate and harmonize them with existing initiatives.

To address threats posed by climate change, the Philippines established the Climate Change Commission (CCC) in 2009 to develop climate policies and oversee their implementation. To fulfil its mandate, it developed the National Framework Strategy on Climate Change (NFSCC), which set the principles for climate action, and the National Climate Change Action Plan (NCCAP), which set targets and priority actions for 2011 until 2028. In 2015, as a response to the Lima Call to Action, the country submitted its Intended National Determined Contribution (INDC), with commitments anchored to the NSFCC and the NCCAP, to the United Nations Framework Convention on Climate Change (UNFCCC). Pledges relevant to MHEW systems for coastal hazards are improving the country's climate monitoring capacity and to making development climate and disaster resilient (Republic of the Philippines, 2015). In 2017, the country acceded to the Paris Agreement, which officially makes the INDC the country's contribution to the goals of agreement. Following its accession, the CCC has conducted consultations to create an NDC roadmap to guide its implementation (CCC, 2016). The opportunities to better integrate disaster risk reduction efforts with climate change adaptation should be a crucial point in this roadmap – a recent case study reveals an uneven focus on post-disaster impacts rather than on reduction of vulnerability, which could worsen due to lack of sustained funding, near-real-time information, and support at the community-level (de Leon and Pittock, 2017).

The country's efforts to address disaster risks mirror its climate efforts. In 2010, it enacted the Philippine Disaster Risk Reduction and Management (PDRRM) Act. The act led to the creation of the NDRRMC as the policymaking and coordinating body for DRR initiatives. To fulfil its mandate, it developed the National DRR Framework and the National DRR Action Plan 2011 to 2018 that are largely based on the objectives of the Hyogo Framework for Action (HFA). Following the adoption of the Sendai Framework for Risk Reduction (SFDRR) in 2015, NDRRMC has conducted a number of workshops for its implementation in the country (NDRRMC, 2016). Consultations are also underway to amend the PDDRM Act (OCD, 2016), which proposes a number of changes following the SFDRR. Priority actions under SFDRR that contribute to improving MHEW systems for coastal hazards are improving risk knowledge and risk governance and increasing investments that enhance resilience and preparedness.

Although, without a law dedicated to upholding sustainable development, the country established the Philippine Council for Sustainable Development (PCSD) in 1992. Composed of different national government agencies led by the National Economic Development Authority (NEDA), the PCSD was tasked operationalize and oversee the country's sustainability commitments, called Philippine Agenda 21. After the global adoption of the Millennium Development Goals (MDG) in 2000, a multi-sectoral committee, similar to PCSD and still led by NEDA, was established oversee the implementation of MDGs in the country (Asuncion, 2016). NEDA is also overseeing the implementation of the SDGs. To prepare for implementing the new set of goals, NEDA evaluated its performance in implementing the MDGs and is currently holding multi-stakeholder consultations to devise new strategies and establish partnerships (Edillon, 2016). Among all SDGs, goal 11, which aims to make cities safe, resilient, and sustainable, is most relevant to MHEW systems. Alternatively, it can be argued that all goals contribute to MHEW systems because increased human and environmental well-being reduces vulnerability and increases the capacity of communities to respond to disaster risks.

7.1.2 Interview and Focus group findings

The main focus of the HFA was improving on hazard prevention and preparedness. The Philippines has achieved some measure of success in this aspect given the improvements made to early warning systems (PIO17). However, the operationalization of HFA has been selective and uneven given that not all local government units are familiar with the HFA (PIA16). In addition, there is still a gap in terms of making the connections between hazards and vulnerability, exposure and risk. The framework changed with SFDRR to look at whole-society (PIG14, PIO17), multi-hazard integrated risk assessment, with more focus on resilience (PIO17).

A big challenge for the implementation of the SFDRR is considering resilience from the ground up and identifying (1) what are the science and technology needed to enable evidence-based decision-making to really happen; and (2) what innovative and non-traditional partnerships are needed across different stakeholders to enable solutions (PIO17). For example, there are government agencies identified by law as the lead organizations for addressing risk from specific hazards: e.g., PAGASA, Department of Interior and Local Government (DILG), Office of Civil Defence (OCD) and the local governments for storm surge, and PHIVOLCS, DILG, OCD and the local governments for tsunamis. However, the private sector generates risk but can also contribute to reducing risk, and so should be engaged (PIO17). Launched last October 2017, newly formed National Resilience Council, for example, includes representatives from national government, NGOs, research institutions and the private sector.

The objective to building resilience from the ground up means that making these international agreements work locally is a major concern (PIN12, PIA16, PIO17). The Department of the Interior and Local Government (DILG) is the key agency in cascading these international frameworks locally. LGUs are integral in the implementation of these frameworks, NGOs like CDP exist to fill gaps and complement efforts. Directives, policies,

plans and guidelines for integration should flow both top-down and bottom-up, from national government to the regions to the provincial government to the LGUs (cities/municipalities) then to barangays, and vice versa.

Some LGU representatives during the FGD and interview claimed that the efforts of the LGUs are very minimal in terms of the post 2015 global framework which resulted in poor performance on various development goals and not being aligned with the international framework and guidelines. This could be attributed apparently to the lack of understanding by the local chief executives on how to localize and contextualize these global frameworks, and lack of research to generate evidence needed for decision support.

Success is also limited by political turfing, limited awareness and empowerment of communities to demand accountability. The silo approach in implementation and lack of interconnectedness among LGU offices still persist, and the impacts of capacity-building activities such as trainings are limited because when the people who are trained return, they rarely are given the opportunity to share and enact what they have learned. Resources are not allotted properly to ensure implementation of policies (PIA13), which may be related to reported difficulties of LGUs to comply with Commission on Audit (COA) requirements regarding their Annual Investment Plan (PFA01, PFA02, PFL03).

There are also issues in the bottom-up feedback processes. Local concerns are much harder to incorporate in designing national policies in response to global frameworks. Data from LGUs can overwhelm national agencies. According to the experience of PIN12, in some cases, when the national agencies conduct consultations, they do it with civil society organizations that may know little about the concerns of the community. PIN12 also avers that some of the global frameworks may be inherently difficult to achieve, particularly level of ambition vis-à-vis the country's development realities. For example, the use of schools and gyms as evacuation centres does not conform to international standards set by the framework. Indicative also of non-compliance is the construction of the local government's evacuation center in land that has soil liquefaction (PFL03).

Interestingly, the NGO respondent (PIN12) felt that the SFDRR regressed compared with HFA because the need for addressing underlying causes of disasters like poverty had been excluded. "Internally Displaced Groups" are also excluded and replaced with migrants. Admittedly, another big challenge for the SFDRR is helping communities with articulating their "resilience challenge." They can explain their "preparedness challenge" and their "response challenge", but do not do as well with their "resilience challenge" in terms of locating the issue of resilience within their local context and within their larger development goals (PIO17). Our paradigm for growth needs to be re-evaluated (PIA13) – planning for sustainability is not strong enough, as the focus in some areas is to industrialize, leading to a situation in which development gains, for instance, can be set back by one typhoon.

8. Current National efforts towards MHEW in Coastal Resilience

8.1.1 Literature Review findings

There are a number of disparate efforts at the national level that contribute to MHEW and resilience in coastal areas. Although not explicitly dedicated for coastal areas, the following nevertheless cover coastal concerns:

- The Housing and Land Use Regulatory Board (HLURB, 2014) developed guidebooks for local governments in developing comprehensive land use plans (CLUP). These guidebooks include instructions for assessing and mapping the following hazards: rain and earthquake-induced landslides, flooding, storm surge, tsunami, volcanic hazards, and ground shaking. It likewise contains for creating composite hazard and risk maps. HLURB also developed supplemental guidelines for climate change adaptation (CCA) and DRR which cover coastal development planning. In this document, local governments are asked to note secondary impacts of sea level rise, flooding, and storm surges such as coastal erosion, loss of coastal wetlands, and saltwater intrusion (HLURB, 2015)
- The Department of Science and Technology, through its monitoring agencies, PAGASA and PHIVOLCS, also assess and map hydro-meteorological and geophysical hazards, respectively. In addition to hydro-meteorological hazard events, PAGASA is also downscaling global climate models to assess the longer-term impacts of climate change to local weather events and patterns (PAGASA, n.d.) MGB, also, to a limited extent, conducts flood and landslide hazard mapping. Among these agencies, there is little evidence whether common hazard assessment and mapping guidelines are being developed and whether attempts at streamlining their efforts are being carried out. In terms of assessing hazard evolution, current efforts are inherently limited because the methods that they employ only note earth processes and exclude the influence of socio-economic and development processes in shaping hazard trends.

In 2014, the government enacted an integrated coastal management policy (EO 533) to streamline efforts to develop the country's coastal and marine environment. It tasked the Department of Environment and Natural Resources (DENR) to develop a National Integrated Coastal Management Plan (NICMP) that will run from 2013-2016. Part of the NICMP is to institute a sustainable development program that covers initiatives to reduce and manage coastal hazards. The success and possible complementarity of this policy with the initiatives of other government agencies, however, is difficult to evaluate because of limited documentation.

8.1.2 Interview and Focus group findings

At the national level, initiatives for disaster resilience are organized under the National Disaster Risk Reduction and Management Plan (PIG14). Multi-hazard early warning systems are critical since they enable stakeholders to respond timely and appropriately, thereby greatly reducing the loss of lives. MHEW systems are *"continuously being improved with the planned installation of additional doppler radars, earthquake monitoring stations and sea-level monitoring stations which will cover storm surges and tsunamis (PIG14)."* These improvements for monitoring geophysical hazards reflect the modernization efforts of most warning agencies to enhance their capacity detect hazards and issue timely warnings (PIG18).

Department of Science and Technology (DOST) agencies (PAGASA and PHIVOLCS) are the primary sources of information materials and warnings, which are disseminated to the public through social media, broadcast media, text messaging, or the communication systems of NDRRMC, member national agencies and local governments. At the local level, capacity-building, preparedness and awareness activities can be initiated and implemented by various organizations (PIG14) including educational institutions, e.g. universities (PIA13). However, the management of coastal areas, specifically, is hampered by fragmented institutional arrangements (ENROs, BFAR, different municipalities), outdated and conflicting policies, & limited manpower (PIN12).

At the national level, the approach to EWS and resilience has been mainly technocratic. PIN12 avers that EWS can promote resilience but is not an assurance of resilience. EWS should go beyond the availability of technologies and dissemination of warnings towards localizing information so people understand what the threats are and how to respond to them. Local and indigenous knowledge, cultural practices and beliefs, and risk perceptions also need to be incorporated. EWS needs to account for how people receive and respond to warnings, which are largely influenced by local contexts (PIN12, PIA15, PIG18). There are many other factors coming into play that are not usually considered when defining the issue of early warnings in local communities as a "communication", "dissemination" or "translation" problem. Warning messages are "encoded" by experts (e.g. PAGASA or PHIVOLCS) in a specific way, according to their own training and understanding; however, the audience will "decode" it and act/not act on their own terms, on the basis on different contextual variables that influence local worldviews (PIA15). Decoding is not a problem of communication but of "embodied epistemologies" (PIA15).Thus, mere dissemination of information is not sufficient, since it is an "*outdated method that disregards cultural nuances… it prevents us from seeing how people understand the message because we are so concerned with constructing a message that we believe will suit all audiences* (PIA15)." Thus, dialogue and collaboration are required among national-level scientists and decision-makers, social scientists, and local stakeholders to understand how people respond to warnings.

Another challenge at the local level is the potential for response that is maladaptive. According to PIN12, in Malabon and Novaliches, for example, people have become accustomed to waist-high floods and deem these as "normal," hence the lack of urgency to

evacuate. This is an example of risk perception resulting in maladaptation. Furthermore, PIN12 comments on the political economic of vulnerability to hazards, since populations in the margins already find day-to-day living a struggle, resulting in another maladaptive example of welcoming disasters because these bring access to relief goods.

CDP (PIN12) as an NGO conducts simulation exercises in their areas for responding to floods and typhoons. They help communities assess hazards, organize Barangay Disaster Risk Reduction and Management Councils (BDRRMC), and develop and institutionalize with BDRRM Plans. Most barangays have these councils (compliant with the law) but these are rarely operational. Implementation success is largely dependent on presence of proactive leaders/local government executives. Short electoral cycles/terms in office also hamper the sustainability and continuity of the local plans and councils. The technical capacity of LGUs to develop plans is also often limited, leading them to hire external consultants. Commonly, these plans include the purchase of equipment, medicine, and relief goods and are less focused on capacity-building and other proactive preparedness activities. CDP therefore implements a multi-level engagement with communities at local level, and agencies at national level through consultations and participation in technical working groups of the Office of Civil Defence and other national government agencies (NGAs).

9. Policies to improve MHEW in Coastal Resilience

9.1.1 Literature Review findings

The current paradigm for disaster risk reduction and management in the Philippines, which was established in 2010, represents a shift from the previous approach which was predominantly a limited warning-response-relief model. The Presidential Decree 1566, promulgated on June 11, 1978 was formerly the basic law describing the disaster management policy, institutional and operational framework in the country. This law created the Disaster Coordinating Councils from national to barangay level. The National Disaster Coordinating Council (NDCC) supervised the implementation of the Philippine Disaster Management System, with the OCD serves as its operating arm for the discharge of functions. Disaster management functions were classified into 3 phases: pre-disaster, emergency and post-emergency. Preparedness actions in the pre-disaster phase include Preparedness actions include planning, community-organizing, training, equipping, stockpiling, hazard mapping and public information and education initiatives. Early warning systems were considered part of the emergency phase. Agencies responsible for forecasting are the Philippine Atmospheric, Geophysical, Astronomic Services Administration (PAGASA) for meteorological hazards, Philippine Institute of Volcanology and Seismology (PHIVOLCS) for geophysical hazards, Philippine Nuclear Research Institute (PNRI) for radioactive fallout or contamination, Department of Health (DOH) for diseases and epidemics, and the Armed Forces of the Philippines (AFP) and Philippine National Police (PNP) for civil disturbances or unrest (ADPC 2001, p. 27).

Currently, the same institutions are still mandated to issue early warnings for their assigned hazards. However, the basic framework has evolved from a predominantly disaster coordination and response perspective to a focus on risk management with the 2010 Republic Act 10121, the Disaster Risk Reduction and Management Act. The new framework under this act recognizes that a more proactive approach was needed, with more weight given to prevention and mitigation compared to preparedness, response, rehabilitation and recovery (NDRRMC, 2011). The framework explicitly acknowledges the need to transition from a single-hazard approach to a multi-hazard or “all-hazard” approach. Furthermore, it was recognized that not only should science, technology and engineering solutions be promoted (e.g. for hazard analysis and forecasting), but these can be complemented with non-structural/engineering measures be promoted such as the community-based initiatives and the use of indigenous knowledge. More importantly, the paradigm shift recognized the need to address vulnerabilities and adaptive capacities, especially in the face of climate change, aside from hazards (NDRRMC, 2011). Given this the NDCC was restructured into the NDRRMC – the National Disaster Risk Reduction and Management Council.

This paradigm shift now extends to the other institutions tasked to assess and address the broad spectrum climate and disaster risks, which, as a corollary, cover coastal hazards. They have created plans and policies to improve hazard and risk knowledge, detection and forecasting capacity, and public awareness. These create the opportunity to strengthen the

development and implementation of MHEWs, and to frame these within the larger umbrella of risk and resilience.

The effectiveness of these initiatives, however, are difficult to assess without baseline information, agreed performance metrics, and periodic reports. The attempted integration of the disaster risk management agencies and practitioners and the climate change adaptation practitioners also created a need to resolve differences in definitions for concepts such as “exposure”, “vulnerability” and “risk”. These institutions also do not have an operational definition of resilience, which makes evaluating policies that profess to improve resilience difficult.

Potential implementation concerns also include:

- Capacity of institutions to carry out their mandate: The NDRRMC, for example, is required to review its NDRRM Framework every five years but as of this writing, no review has been conducted. The local governments are likewise required to come up with their own integrated “ridge-to-reef” plans that address land use needs, and reduce risk to relevant hazards in addition to being “climate-proof”. But to date, only 24 cities and 135 municipalities have local climate change action plans (LCCAP) (DILG, 2016).
- Considerable overlap of objectives and activities: While not a problem in itself, it runs the risk of duplicating efforts with limited human and financial resources; or worse, resulting in conflicting measures.
- For EWS in particular, while policies profess to be more participatory, action plans are still knowledge prescriptive. Moreover, despite claiming to adopt an all-hazards approach, assessment guidelines and action plans remain focused on rapid-onset hazards.

9.1.2 Interview/Focus Group findings

The Disaster Risk Reduction and Management Act (RA10121, which created the NDRRMC) *“has provided a framework which enable communities to be more proactive than before … The National Disaster Risk Reduction and Management Plan has stated outcomes and indicators that national agencies need to achieve (PIG14).”* The Department of Science and Technology (DOST) has developed a roadmap towards addressing risk and building resilience (PIO17). Under the RA10121, DOST is tasked to produce 4 documents: the National Disaster Preparedness Plan and National Disaster Response Plan, which have already been produced; and the National Disaster Prevention Plan and National Disaster Recovery Plan, which have not yet been produced (PIO17, PIG14). DOST agencies PHIVOLCS and PAGASA have also developed hazard-specific documents such as the “Standard Operating Procedures for Tsunami and Storm Surge” and “Developing a Tsunami Prepared Community” (PIG14). To improve PAGASA’s capacity to detect and issue timely warnings for hydro-meteorological hazards, the congress also passed PAGASA Modernization Act (PIG18).

Policies at the national level are translated into corresponding policies and plans at the LGU-level. For example, for the Preparedness pillar, the Department of Interior and Local Government was identified as the lead agency, resulting in increased preparedness activities at the community level (PIG14). DILG has been spearheading “Operation Listo” (“Listo” roughly translates to “a state of being ready”) a program that institutionalizes local protocols and develops disaster preparedness manuals for LGUs (PIN12, PIG18). The NDRRMC has its counterparts in city/municipality and barangay-level DRR officers. The National Climate Change Action Plan needs to be translated into Local Climate Change Action Plans that are consistent with the Comprehensive Land Use Plan (CLUP) and Comprehensive Development Plans (CDP) & Annual Investment Plan at the LGU level (PIN12).

Concerns were raised by respondents regarding organizational issues and capacities of institutions to actually implement said policies and plans. At the national level, the NDRRMC is under the spotlight – the FGD group (PFA01, PFA02 and PFL03) questioned whether its mandate and responsibilities were clear, and whether, as a coordinating body, the NDRRMC actually has the resources, authority and legal personality to carry out its function. The FGD group also expressed concern over the application of templates for the incident command system since the material was based more on a western then Philippine setting.

At the local level, compliance with the required plans is an issue (PIN12). Continuity is a challenge because plans may change as elected officials change every 3 years. The impacts of these plans in terms of improving EWS and resilience uneven, due limited capacities and resources, particularly their internal revenue allotment; the quality and interest of leadership; and the extent of organization and level of engagement among stakeholders. The mandate of the local DRRMOs also need to be clarified (PFL03).

10. Resilience Mechanisms

10.1.1 Literature Review findings

There are three broad approaches to manage and respond to disaster risks. They are to change activities and development patterns avoid risk, to engage in incremental changes to reduce the magnitude of the hazard event or disaster impacts, and to accept losses (Klein, et al., 2003). In the Philippines, government response has largely been to engage in incremental actions to modify the hazards and reduce disaster impacts. In particular, up until the recent decade, investments in infrastructure and relief provision have been the conventional government responses (Predo, 2010; Zoleta-Nantes, 2000). Several provinces, for instance, have constructed dams and seawalls to address flooding and storm surges (Gaillard, et al., 2008).

While investments in infrastructure and relief provision remain the favoured responses, the adoption of the Hyogo Framework for Action in 2005 and the passage of the National DRR law in 2010, ushered in other types of responses. PAGASA, for example, is promoting community-based early warning systems as a non-structural flood mitigation measure (Perez, et al., 2007). A number of projects were also implemented to improve local risk knowledge, hazard monitoring, and response capacity. An example is Climate Change Commission's (CCC) project, with the assistance of the United Nations Development Program (UNDP), called Resilience Capacity Building for Cities and Municipalities to Reduce Disaster Risks from Climate Change (ReBUILD) that assessed the vulnerability of communities in two river basins, generated flood maps, raised community awareness on flood risk, and supplemented the implementation gaps of the community's early warning system (CCC, n.d.). Another example is CCC's, with a grant from the Australian government, Project Climate Twin Phoenix- Resilience and Preparedness Toward Inclusive Development (PCTP-RAPID) that assisted selected LGUs to assess and map flood hazards, install flood gauges, and develop flood response plans (CCC, n.d.). Aside from the limited coverage (both geographic and types of hazards) of these projects, sustainability is also a concern. Other related efforts that still fall under hazard and impact reduction are incorporation of DRR and CCA in school curriculum (DepEd, 2015), that covers activities such as hazard drills and mapping, and dissemination of risk information on new media such as Project NOAH's webGIS and hazard maps (see: (http://center.noah.up.edu.ph/), and NDRRMC's Batingaw mobile application that lists safety tips for a number of hazards (see: https://play.google.com/store/apps/details? id=com.batingaw.tudlo&hl=en).

Although not as common, there are also strategies that fall under risk avoidance and risk acceptance. For the former, the HLURB and local governments have prescribed easements and no build-zones. Efforts to enforce zoning, however, have been largely unsuccessful (IRIDeS, 2014) because of general public resistance to land control (Zschau & Kuppers, 2003). Moreover, in evaluating acceptable risks that inform these zoning ordinances, governments tend to base it solely on economic terms and ignore personal risk perceptions (Keller & DeVecchio, 2015). For the latter, there have been attempts to introduce risk transfer mechanisms in the country, particularly for the agriculture sector. Farmers, for

instance, can have their crops and livestock insured by the Philippine Crop Insurance Corporation. Most farmers, however, do not avail of the scheme, citing financial constraints (NDCC, 2009).

10.1.2 Interview and Focus group findings

Coastal resilience mechanisms consist or both soft and hard measures. Soft measures have included LGU investments in disaster trainings and mangrove planting (PIN12). The latter, however, has been found to be inadequate – success metrics have only considered the number of seedlings and the hectarage planted, but according to PIA13, the survival rate is only at 11%, and the planting method and selection of sites has been questionable. Mangroves can only be effective as protection against coastal hazards such as tsunamis when they are dense, which requires 2-3 decades of planting. According to PIA13, some LGUs have employed ecosystem-based measures that can help protect against coastal hazards, but these are only co-benefits to other policy objectives such as the establishment of MPAs or increasing fish catch (rather than the mitigation of coastal hazards explicitly).

Hard mechanisms have included the building of infrastructure such as seawalls and dikes (to be developed in boulevards or tourism spots) (PIN12). According to PIA13, hard measures such as infrastructure should be the last resort after other options have been exhausted; however, we tend to start with these because they are politically attractive and create a sense of protection and security, although false. Hard structures should be complemented by other mechanisms such as relocation. In contrast, PIN12 opines that relocation of exposed populations rarely works when their livelihoods are connected to the coast – skills are not readily transferrable.

Insurance was also identified as a mechanism under the Prevention and Mitigation pillar of the National Disaster Risk Reduction and Management Plan (PIG14). In some areas in the Western Visayas, there was an insurance scheme for marine culture at one point but it is no longer operational after it failed to anticipate Typhoon Frank (PIA13). In addition, the insurance is mostly for hard structures – boats, engines, cages – with nothing for catch or fishes for marine culture (PIA13).

Most of these mechanisms, although not entirely disconnected from national development plans, are largely driven by local experiences and concerns. Local disaster plans may be required down to the barangay level (e.g., as in Sta. Rosa, Laguna; PFL03). Funding may be made available even for research-type initiatives as long as these can be justified as being related to disaster risk and being aligned with the mitigation and preparedness pillars of the DRRM framework (PFL03). Marikina City is an example in Metro Manila of an LGU that has completed its disaster response system as the pilot test area of Project NOAH (PFA01, PFA02). The establishment of the dedicated local capacity-building institutions (such as Climate Change Academy in Sorsogon) and the inclusion of other coastal hazards issues such as soil liquefaction should likewise be explored into to supplement disaster preparedness of the city (PFA02).

However, some LGUs also have concerns on the limitations of devolution (e.g. how national agencies get to ultimately decide what to do with local resources). Development and disasters are closely linked, but national development plans are not always aligned with the needs of the regions and targets may be unrealistic (PIN12). For example, large investments in infrastructure are concentrated in Metro Manila as the National Capital Region (NCR), with fewer resources directed to poor regions like the Autonomous Region of Muslim Mindanao (ARMM).

11. Regional Cooperation

11.1.1 Literature Review findings

The Philippines is part of two regional partnerships that support effective MHEW and disaster resilience. Although not exclusively for coastal concerns, these partnerships cover coastal hazards and contribute to disaster resilience of coastal communities.

- ASEAN Agreement on Disaster Management and Emergency Response (AADMER) – entered into force in 2009 and is the first legally binding instrument to come out of the Hyogo Framework for Action (HFA). It was established to promote cooperation and collaboration in reducing disaster losses and in undertaking joint emergency response (ASEAN , 2016). Its work program for 2010 to 2015 covered regional risk assessments, effective and efficient regional early warning activities, hazard monitoring to support mitigation efforts, and undertaking response and recovery activities. The succeeding work program for 2016 to 2020 still considers enhancing risk assessment and risk awareness as priority programs, but emphasis is largely on protecting gains from community integration trough social protection programs and improving the resilience of infrastructures and essential services (ASEAN, 2016). It also established the ASEAN Disaster Management and Emergency Relief Fund from voluntary contributions of its member states.

- Regional Integrated Multi-Hazard Early Warning System for Africa and Asia (RIMES)- is an intergovernmental organization established in 2009 to provide its members regional early warning services for tsunami and hydro-meteorological hazards. It likewise builds the capacity of its members to effectively transmit the warnings to the people at risk (end-to-end EWS). At present, it has 12 member states and 19 collaborating countries from Asia and Africa.

11.1.2 Interview and Focus group findings

The Philippines is part of several tsunami early warning systems and preparedness initiatives (PIG14):

- The Pacific Tsunami Warning System (PTWS)
- Regional Integrated Multi-Hazard Early Warning System (RIMES) for the South China and Indian Ocean region
- South China Working Group on Tsunami Early Warning system.

"The operational PTWS and RIMES provide regional earthquake and tsunami information, which supplements PHIVOLCS monitoring of national to regional earthquakes and tsunami. PHIVOLCS has developed Tsunami Standard Operating Procedure with UNESCO through International Tsunami Information Center (ITIC), PTWS and shared its experience with Vietnam. Exchange of educational materials with other countries has been facilitated

through ITIC and UNESCO. Research and applied activities on tsunami hazards assessment and evacuation planning have been conducted with RIMES (PIG14).”

The Philippines is also part of the ASEAN Agreement on Disaster Management and Response (AADMER), which includes the ASEAN Humanitarian Assistance Centre (AHA). This needs to be updated though because they were designed using the Hyogo Framework for Action (HFA).

Regional collaborations within ASEAN can be a challenge due to the differences in hazards experiences – other ASEAN countries are not frequently hit by typhoons as the Philippines (PIA13, PIG18). According to PIN12, the ASEAN is also divided in other issues (e.g. on territorial disputes) which affect effective cooperation in DRM.

For biological hazards, there is a Southeast Asia Harmful Algal Bloom network that estimates the extent of algal blooms but its function is not primarily predictive. It is intended for monitoring impact on aquatic commodities and export/import restrictions. For human-made hazards, PIA13 recalls a South China Sea oil spill program supported by JICA but this was only active for a few years.

PIA13identified the following needs to improve on regional cooperation for coastal resilience:

- Identify capacity needs – e.g. automatic warning-response system that will remove the need to wait for an agency to release warnings
- Innovation – especially for biological hazards (e.g. microsatellites)
- Training – local officers are not equipped to handle coastal issues (in the Philippines: communities often hire foresters because of preference for licensed degrees)
- Partnerships – include sociologists and anthropologists even during planning not only during disasters

PIG14 further said that the infrastructure and business resiliency should also be addressed, which requires the involvement of various socio-economic actors.

12. Enablers associated with MHEW in Coastal Resilience

12.1.1 Literature Review findings

Studies examining the factors that contributed to improving the country's MHEW system and coastal resilience are scant. At the subnational level, there is anecdotal evidence that proactive local chief executives are instrumental in developing effective early warning systems and DRRM plans in their territories. Governor Salceda, for instance, is often credited for the province of Albay's success in avoiding casualties during hazard events (Santos & Pacia, 2015). At the national level, disasters seem to have precipitated initiatives to improve the country's risk knowledge as well as monitoring and forecasting capabilities. Project NOAH, for instance, was established after tropical storm Washi (local name Sendong) wreaked havoc in Cagayan de Oro. PAGASA was also modernized after it failed to accurately forecast the track of typhoon Conson (local name Basyang) and devastated Metro Manila (Congress of the Republic of the Philippines, 2010). Even the passage of the country's climate change law was accelerated after Typhoon Ketsana (local name Ondoy) submerged most of Metro Manila (Senate of the Philippines, 2009).

12.1.2 Interview and Focus group findings

Enablers identified by respondents span research output and technological systems, decision-support and policy systems, and education and capacity-building systems. Research products include hazard and risk assessments (PIG14). Technological systems include hazard-specific and localized EWS (PIN12, PIA13), real-time monitoring systems, for earthquake, sea level detection, and redundant multi-platform or multi-modal warning and information systems (PIG14). Other structural measures include critical infrastructures (hospitals, schools, evacuation centers) located away from the hazards and designed with adaptive considerations, and dedicated evacuation centers (PIA13).

Policy systems include a suggested national planning and monitoring agency dedicated for archipelagic affairs, which can link with other government agencies (this is currently absent) (PIA13). This proposed office may be able to help convince local politicians, for example, to help carry out unpopular measures such as no-build zones or relocation because they are framed as a requirement by this agency. Longer-term considerations need to be built into zoning ordinances and development plans to account for multiple hazards and manage population size (PIA13). A stronger system of accountability also needs to be put into place for LGUs (PIN12). Political will is regarded as an important enabler (PIN12), given the examples set by proactive and progressive politicians/local executives (E.g. as currently seen in Sabang, Albay) (PIA13).

On the community capacity-building and preparedness aspect, disaster planning must be inclusive and appropriate to local contexts. Technical information in messages relayed need

to be simplified while maintaining accuracy (PIN12) but the characteristics of intended receivers of the message must be considered as well. This means examining how capacity to respond is closely linked to contextual variables such as education (PIA15) and economic status (e.g. households may want to have go-bags and stockpile goods but may have little resources to purchase them) (PIN12). Designing measures should also always take into account the concerns of stakeholders and cultural practices (PIA13). To some extent, this might involve examining paradigms and worldviews of stakeholders, for example, their attitudes towards risk (e.g. the notion of being used to flooding – "sanay sa baha" – in a maladaptive way, and whether we can appreciate probabilities and uncertainties inherent in "risk") (PIA15).

Good governance, as an enabler, can therefore be defined as the nexus between the community capacity-building systems and policy systems, as informed by evidence from the research and technological systems. Good governance refers not just to active, efficient local government units but also active, efficient citizenry; i.e., how people and LGU work together, and how LGU works with higher levels of government (PIA15). Communication processes, as enablers, also reside in this nexus - communication will not work without the infrastructure of good governance (PIA15).

PIG18 classifies all these enablers into three broad types: institutional support for all relevant stakeholders, enabling environment, and a monitoring and evaluation framework. The table below summarizes the responses on key enablers of effective MHEW systems and resilience mechanisms.

Table 3. Critical factors that build resilience and improve effectiveness of MHEW systems according to respondents. Factors are grouped according to UNISDR's (2009) elements of EWS.

Enablers	Interviewee code	Frequency of mentions
Building risk knowledge		
• Research outputs (including hazard and risk assessments, validation)	PIG14, PFA01, PFA02, PFL03, PIA04, PIG05, PIA06, PIA07, PIL08	9
• Education	PIG14, PIA04, PIG05, PIA06, PIA07, PIL08, PIG11	7
• Information sharing	PFA01, PFA02, PIA04, PIG05, PIA06, PIA07	6
Strengthening monitoring and forecasting capacity		
• Technological systems for real-time monitoring and forecasting	PIG14, PIN12, PIA13, PIN15, PFA02, PIA04, PIG05, PIA06, PIA07, PIL10	10
Improving systems for warning dissemination		

Enablers	Interviewee code	Frequency of mentions
• Communication systems that deliver timely and accurate messages.	PIA15, PIN12, PIA13, PIL09, PIA04, PIG05, PIA07, PIL08	8
• Warning messages that are responsive and relevant to local contexts	PIA15, PIN12, PIA13, PIA04, PIG05, PIA06, PIA07, PIL08, PIL09, PIL10	10
Enhancing response capacity		
• Inclusive and context-specific disaster plans and measures (e.g. plans that account for risk paradigms, socio-economic and cultural concerns)	PIN12, PIA13, PIA15, PFA01, PFA02, PFL03, PIA04, PIG05, PIA06, PIA07, PIG11	11
• Dedicated evacuation centers and other critical infrastructures (should also conform to international standards)	PIA13, PIN12, PIA04, PIG05, PIA07, PIL10	6
• Evacuation plans and routes	PIN12, PFA01, PFA02, PIG05	4
• Risk transfer and sharing mechanisms such as insurance	PIG14, PIG13	2
Cross-cutting enablers		
• Political will & good governance	PIA13, PIA15, PIG18, PIN12, PFA01, PFA02, PIN12	7
• Dedicated policy and institutional frameworks (such as strengthening/establishing hazard monitoring agencies & instituting national policies and local ordinances)	PIA13, PIG18, PFA01, PFA02, PFL03, PIA04, PIG05, PIA07, PIL08, PIG11	10
• Strong M&E/accountability mechanisms	PIN12, PIG18, PIL09, PIA04, PIL08, PIG11	6
• Capacity-building activities	PIG14, PIG18, PFA01, PIA13, PIN12, PIL10	6
• Multi-stakeholder collaboration and support	PIG18, PFA02, PIN12, PIG14, PIA04, PIG05, PIA06, PIA07, PIG11	9

13. Role of Higher Education Institutes for an effective MHEW and Coastal Resilience

13.1.1 Literature Review findings

Education and research institutions in the country contribute to MHEW and coastal resilience through efforts to improve risk knowledge, forecasting and monitoring capacities, and capacity of communities to respond to impending threats. The effectiveness of these contributions, however, is difficult to assess given the absence of systematic monitoring and evaluation.

The Department of Education (DepEd) and Commission on Higher Education (CHED) are mandated to integrate environmental education and DRR in school curricula at all levels under the Environmental Awareness and Education Act (2008) and the Philippine DRR Act (2010). To fulfil its mandate, DepEd developed a resource manual for DRR (DepEd, 2008) and instituted a comprehensive DRRM in basic education (DepEd, 2015). The resource manual familiarized school administrators with the range of risks that the country is exposed to and the different mechanisms for monitoring and evaluation, while the framework enabled them to develop structured programs and activities that increased disaster preparedness of its students. Activities include student-led hazard mapping and preparedness drills.

Aside from mandating schools to develop disaster contingency plans and hold hazard drills (CHED, 2013), CHED is also supporting research on DRM and climate change adaptation by providing grants other incentives. In particular, it funds topics contribute to enhancing DRR policies, community preparedness, and disaster awareness. It likewise funds research that enhance the country's technical capacity to forecast and monitor hazards as well as mediate their effects. It is likewise encouraging the dissemination of research findings through subsidies for publishing and attending conferences (CHED, 2009).

The Department of Science and Technology (DOST) complements CHED's research initiatives. Its harmonized national research and development agenda for 2013 to 2020 identifies climate change mitigation, adaptation, and disaster risk reduction as one of its priority programs. Expected outcomes under this program are improved capacity to forecast weather and model climate change to inform local DRR planning. Part of the agenda is also to invest in infrastructure for science and technology. Of relevance to MHEW and DRR in particular are investments in remote sensing technology, light detection and ranging (LiDAR), information and communication technology, big data/analytics, and advanced climate change and weather modelling (DOST, n.d.).

13.1.2 Education and awareness programmes: Interview and Focus group findings

The Department of Education has incorporated disasters into the curriculum for Grades 7 and 8 under environmental concerns (PIA13), and into the curriculum for Senior High School Grades 11 and 12 through the course Disaster Readiness and Risk Reduction (DRRR). Individual schools also have their own disaster risk management plans, including the conduct of emergency drills (PFA01, PFA01) and are instrumental in cascading warnings and promoting disaster and environmental education (PIN12). They are often complemented by Parent-Teacher Associations (PIN12). At the college/university level, the Commission of Higher Education recommends environmental science / people and ecosystems subjects but as an elective rather than as required course.

A few academic institutions are offering related graduate degrees, e.g.: the Master of Disaster Risk and Resilience of the Ateneo de Manila University (ADMU); the Masters in Crisis and Disaster Risk Management of the Philippine Public Safety College; and the Master of Science in Disaster Risk Management of the Central Bicol State University of Agriculture.

The following government agencies also play a role in education and awareness by way of providing contents or as part of their Information, Education and Communication. These are the PHIVOLCS as the National Tsunami Warning Center, PAGASA as the National Storm Surge Warning Center, the Office of Civil Defense and Local Disaster Risk Reduction and Management offices at various levels under the supervision of the DILG and the Philippine Information Agency (PIG14).

13.1.3 Role of the HEI: Interview and Focus group findings

Higher education institutions can play multiple roles such as in education (as discussed in the previous section), implementation of policy- and locally-relevant research, technical capacity-building, and advocacy and outreach. These roles are interconnected.

Most respondents agree that research or “knowledge production” (PIA16) is a key task of HEIs. HEIs as centers of innovation can explore and push for new approaches that can be more effective (PIA13). HEIs can also develop training modules or specialized courses for coastal communities (PIG18). Resource persons and experts at HEIs can likewise then help train others or cascade new approaches to lead in improving coastal resilience (PIG14, PIG18). Contributions from HEIs can span the spectrum from research on hazard and risk assessment, to research on community perceptions, to risk communication and management (PIG14), to the development of locally-relevant, scalable, and interoperable MHEW system (PIG18).

Research in science and risk communication, in particular, is lacking – for example, there is little research on how people actually understand the early warning messages (i.e. the concept of “decoding” as discussed in Section 8) given their different cultures and

worldviews (PIA15). PIA15 makes the strong statement that "*it is a waste of time and money to keep on working on translating messages when we don't know if they are being understood.*" The way experts/scientists communicate doesn't match how people understand science, so more research is needed in this area instead of "making assumptions" (PIA15). This examination of local cultures and contexts that affect stakeholders' reception of and action on messages is a huge task, and the government agencies mandated to craft early warning messages and education/awareness materials may not have the time or resources to do this on a national scale. Thus, it becomes all the more strategic to partner with local HEIs to help in this endeavour as part of both their research initiatives and public service.

While public service is an accepted part of the responsibility of HEIs, a question that HEIs have to contend with is the extent to which they should be involved in advocacy. PIA13 avers that HEIs should remain impartial and leave the advocacy to NGOs. In contrast PIA15 & PIA16 feel strongly about advocacy being an integrated part of the university's mission. According to PIA16, advocacies are already embedded in our classrooms and curricula, and even this is not enough – we need to push more strongly for research findings to be translated into appropriate policy directions. In fact, the mere act of choosing which research questions are worth answering, in a sense, already shows a "bias"; thus, the act of research is already an advocacy because what we choose to do research on already reveals what we feel is important (PIA15).

Thus, "advocacy" in the academic perspective may perhaps be understood in terms of "knowledge mobilization", which is the conversion of insights and findings to policies and programmatic thrusts (PIA16). There is a gap between academia's production of knowledge and how this finds its way into policy-making and program design – if it does at all. Ground-truthing and validation are needed to ensure that research outputs are indeed usable by the intended stakeholders (PIA15). The knowledge produced has to be located within a space where other people (policy-makers and program managers) can take action on it; otherwise, there is no mobilization. The consumption of science at the policy and practice level is very low. Raising the consumption of science means that research questions, findings and policy recommendations need to be contextually-driven, not "conjured" up without examining local empirical realities (PIA16, PIA15). Enhancing HEIs advocacy to make their work relevant in policy and practice are particularly critical given that some agencies (e.g. PIG18) perceive that the participation of HEIs in initiatives that enhance risk knowledge and resilience is limited.

Thus, the advocacy function of HEIs is closely tied to its outreach initiatives. By "outreach" here, we refer to the bridging of stakeholders and institutions. Universities can help promote good governance by bridging governing bodies, scientific bodies and organizing bodies with each other and community members (PIA15, PIG18). It is through this bridging and networking that knowledge sharing and mobilization can be facilitated. HEIs need to help with creating a multi-way flow of information rather than the traditional "top-down" process of experts "translating the science" to communities (PIA15).

The demands of research, capacity-building, advocacy and outreach require increasingly inter- and trans-disciplinary approaches. However, many universities still employ a disciplinal mindset, and are in danger of being left behind rather than being the ones leading inter-sectoral collaborations. HEIs need to evaluate its education and training programs – HEIs need to rethink our modalities for teaching, research and outreach to engage stakeholders beyond the academe and to being these stakeholders closer to the academic and research community as well (PIA16). Moreover, the aim of education and awareness needs to go beyond definition of scientific terms and concepts; more importantly, education in communities must inculcate a scientific mindset – i.e. so that stakeholders develop the attitude of asking the right questions, proactively looking for answers, and seeking solutions that address systemic factors rather than symptoms.

13.1.4 Barriers faced by HEIs : Interview and Focus group findings

One of the challenges encountered by HEIs is the lack of resources to implement this kind of research. The Department of Science and Technology (DOST) is one of the main sources of funds and PIA13 thinks that more funding should be allotted to research and to S&T in general. However, there are certain points of tension between government funding agencies and universities that may inhibit a smooth and sustained working relationship towards addressing MHEWs and resilience. One is the differentiation between state universities and colleges (SUCs) and private HEIs. The latter is perceived as having a student population from the higher economic classes and therefore, not prioritized for government grants (PFA02). And in instances when grants are awarded, there are substantial delays in the release of the grant, which necessitates the HEIs advancing the funds needed to undertake the research in a timely manner (PFA03). Another point of tension is a problem of "turfing" or competition between government agencies who are mandated to assess specific hazards and issue the "official" results (PFA02), and the universities that can perform similar research that is treated as supplemental information.

Another challenge faced by HEIs is the additional burden on the part of the faculty members, who have to juggle the demands of a heavy teaching load and administrative work in addition to research and engagement (PIA13). Deloading schemes are needed to allow faculty more time for research. Incentives can also be offered to encourage faculty to support capacity-building of stakeholders, and to become more engaged in local processes, as well as in international bodies and technical working groups. Faculty can help support policy by serving as resource persons in senate hearings.

Faculty can also be trained to work with government organizations that have the specific mandates in for research and communication in the fields of MHEW and resilience – *"there are standard operating procedures and protocols that are being implemented and followed and all those involved in MHEWS need to be acquainted with these (PIG14)."* Such capacity is required in order to fulfil the outreach or bridging function of the HEI.

Lastly, more students are needed in the sciences (PIA13). Teachers need to encourage the natural curiosity of students towards sciences in the midst of cultural expectations that may

be discouraging the youth from pursuing science careers (PIA13). Perceptions of scientists must be changed to “humanize” (PIA13) them more, and better teacher training at the high level is needed, when most students first encounter specialized sciences. This natural curiosity is also an essential part of the scientific mindset that will lead stakeholders to proactively looking for answers and solutions (PIA15).

14. Conclusions

As an archipelago located in the Pacific Ring of Fire and Typhoon Belt, the Philippines experiences a gamut of coastal hazards. Combined with development gaps that drive vulnerability and erode resilience, a number of these hazards occurrences have resulted into disasters. Since the 1950s, storms, and, to a lesser extent, floods are the most common and most destructive hazards in the country.

Part of the response to addressing these disasters were policies and initiatives that aimed to strengthen the country's early warning systems (EWS). The persistence of disasters, however, signify gaps in the current EWS. The following are the critical gaps clustered according to each element of the EWS:

- Risk knowledge: duplication of efforts because the mandate to carry out hazard and risk maps are distributed across agencies with little coordination; limited utility of assessments and maps to planners and decision makers due to, among others, coarse resolution and limited validation; limited capacity of local governments to carry out their mandate; assessment guidelines that focus only on rapid-onset hazards
- Monitoring and forecasting: adequate infrastructure for the common hazard types, namely, storms, earthquakes, and, in urban areas and major river basins, floods; infrastructure for other hazard types, however, are limited; little, or no systematic efforts to consider potential interaction of different hazard types among each other and with the built environment
- Dissemination: primarily top-down, supply side approach to issuing warnings and risk information with little regard to how they are understood and interpreted by the receivers; limited reflexivity of agencies responsible for issuing warnings especially regarding the effectivity of their message and strategies
- Response capacity: clear mandates and manuals for response but implementation is constrained by limited capacity and incompatibility with local priorities and concerns; most of the responses are short-term and reactive (focused on rescue and relief)

In terms of overarching policy frameworks and declarations, the country's positions largely reflect global trends. The most notable is the shift in the focus from prevention and preparedness in the HFA to multi-hazard and integrated risk assessments and resilience in SFDRR that are reflected in the NDRRM Act and the NDRRM Framework. While commendable,

- Practice has yet to catch up with these shifts as efforts are still concentrated on response.
- Governance arrangements, also still, operate in silos, and while there are clear mechanisms for cascading international frameworks locally, its inverse of feeding local concerns back into the national and international agenda is largely undeveloped.

- Existing regional collaborations, in which the Philippines is a part of, are yet to also situate their current narrow focus on hazard monitoring and response efforts to the broader goal of building resilience.

15. Recommendations

To bridge the gap between the intent of policies and frameworks to strengthen EWS and to build resilience, in general, with current practice, good governance is cited as the most critical factor. Unlike the traditional command and control model, good governance in this context means the capacity to integrate and harmonize efforts across sectors and scales.

- Most resilience mechanisms currently being implemented could also benefit from horizontal and vertical integration. For example, the predilection for building large scale infrastructure, such as dams and dikes to address flooding, often ignore other water-related and social concerns that could magnify future risk and erode resilience.
- Other resilience mechanisms that focus on avoidance and acceptance such as land use plans and risk transfer mechanisms can be made more effective if designed with feedback from different stakeholders, not just the service providers in the case of risk transfer mechanisms, but also the intended beneficiaries.

Generally, the gaps in the country's EWS for coastal hazards can be summarized and broadly grouped into two. The first issue is primarily procedural: the EWS is primarily top-down, linear, and carried out in silos. Improving vertical and horizontal integration can enhance its effectiveness. The second issue is substantive: the scope, effectiveness, as well as the method for assessing the effectiveness of the current EWS (from risk knowledge to response capacity) is limited. Given these, potential contributions of HEIs to bridge these gaps are the following:

- Build strategic partnerships:
    - Between HEI and government: To help augment each other's research capacities, in the case of hazard and risk assessments; and to assist with ground-truthing and validation (in the case of local HEIs) of research design and outcomes vis-à-vis local empirical realities. Stronger advocacy of HEIs in terms of knowledge mobilization and the consumption of science is important; but to achieve this, more than just "translation of the science" is needed. We need research on local cultures and worldviews to determine how messages and policies crafted by scientists and receive, understood, and acted upon.
    - Non-traditional innovative partnerships, for examplem with NGOs and private sector, are crucial so that addressing resilience becomes a "whole society" integrated approach.

- Strengthen both top-down and bottom-up coordination and collaboration: the MHEW process seems to be mostly top-down and operating only during the

emergency phase. Required plans (disaster, climate change, land use) and templates also emanate from national directives, and it is not clear what avenues there are for localities to provide feedback. HEIs might be able to help here by engaging local communities as potential partners and co-producers of tools, policies and plans that are adapted to local realities and that can be given as recommendations to higher levels of government.

- For education specifically: move beyond the idea that "education and awareness" simply refers to providing the content – e.g. defining terms and scientific concepts – or even teaching skills (e.g. GIS). More importantly, basic education units and HEIs need to cultivate a "scientific mindset" such that stakeholders have the culture of proactively looking for answers to their questions (e.g. so even if they don't understand "storm surge" they will be motivated to look for more info), seeking systemic solutions, and thinking long-term and holistically. HEIs is particular tend to be set up along disciplinal lines (e.g. departments are by discipline). If we do not re-evaluate our modalities make them more inter- and trans-disciplinary, we will be ill-equipped to bridge the different sectors and to translate research outputs in concrete and usable policies and programs.

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APPENDIX 1:

The following table lists all the policies, guidelines, national/local report available for MHEW in Coastal Resilience.

This table lists all the policies, guidelines, national/local report available for MHEW in Coastal Resilience, as used in the LITERATURE REVIEW:

Name of the Document	Reference	Description	Main Initiatives/Actions Highlighted
Philippine Disaster Risk Reduction and Management Act (Republic Act 10121)	Congress of the Philippines, 2010 http://www.ndrrmc.gov.ph/attachments/article/45/Republic _Act_10121.pdf	Aims to strengthen the country's institutional capacity to manage disaster risks and increase the resilience of communities	• Reconstitutes the National Disaster Coordinating Council (NDCC) to NDRRMC and the central body for policymaking, coordination, and disaster response. • Mandates the NDRRMC to develop a DRR framework that is all hazards, multi-sectoral, inter-agency, and community based. • Requires the NDRRMC to develop risk transfer mechanisms and systems for early warning, emergency alert and communication. • Mandates NDRRMC to facilitate the establishment local DRRMCs that will then be responsible for local risk assessments and developing local DRR plans • Earmarks at least 5% of local revenue as Local DRRM Fund. Of which, 30% will be for quick response activities while the remaining fraction is allocated for longer term risk reduction and mitigation initiatives.

Name of the Document	Reference	Description	Main Initiatives/Actions Highlighted
National DRRM Framework	NDRRMC, 2011 http://www.ndrrmc.gov.ph/attachments/article/1675/NDRRMC_Framework.pdf	Sets the direction and priorities for DRR in the country. Part of the efforts to implement the country's DRR act as well as its international commitments under the Kyoto Protocol, Millennium Development Goals, and the Hyogo Framework for Action	• Declares paradigm shifts from centralized DRM to more participatory and bottom-up approaches, viewing disasters as a result of natural hazards to disasters as indicators of social vulnerability, and emphasis on disaster response to a more integrated and proactive approach to human development • Sets key results areas based on the phases of DRM. Areas relevant to coastal MHEW are: prevention and planning, with efforts to assess, monitor, and analyse risks, as well as create risk transfer mechanisms; and preparedness, with efforts to improve community understanding of risks and their drivers and enabling communities to develop local contingency and response plans
National DRRM Plan for 2011-2018	NDRRMC, 2011 http://www.ndrrmc.gov.ph/attachments/article/41/NDRRM_Plan_2011-2028.pdf	Operationalizes the NDRRM Act and Framework. Also contributes to the country's implementation of the MDGs, HFA, and the National Climate Change Action Plan	• Assigns intended outcomes to relevant agencies • Priority projects are the following: local DRRM plans, guidelines for disaster mitigation, response and preparedness, end-to-end local flood EWS as well as criteria for classifying and certifying local flood EWS, hazard and risk mapping, risk financing plan

Name of the Document	Reference	Description	Main Initiatives/Actions Highlighted
Strategic National Action Plan for 2009 to 2019	NDCC, 2009 http://www.adrc.asia/countryreport/PHL/2009/PHL_attachment.pdf	Developed to implement HFA	• Adopts a multi-hazard approach in managing disaster impacts • Has five strategic objectives: improve information and database generation, knowledge management, conduct information and education campaigns, enhance warning systems and conduct vulnerability assessments, and develop tools for monitoring efforts
Climate Change Act	Congress of the Philippines, 2009 http://climate.emb.gov.ph/?page_id=68	Aims to mainstream climate change policies and develop the capacity to address climate risks. Also instituted as a party to the United Nations Framework Convention on Climate Change (UNFCCC) and the HFA	• Creates the climate change commission (CCC) to craft and mainstream climate concerns in policies, and to facilitate the development of risk sharing and transfer mechanisms • Mandates the CCC to draft a national framework strategy on climate change, and a national climate change action plan. Also requires local governments to create local climate change action plans

Name of the Document	Reference	Description	Main Initiatives/Actions Highlighted
People's survival fund (Republic Act 10174)	Congress of the Philippines, 2011 http://www.officialgazette.gov.ph/2012/08/16/republic-act-no-10174/	Amends the climate change act and create a long-term financing stream for local adaptation projects (at least Php1 billion annually)	• Mandates CCC to formulate guidelines for accessing the fund, and help local governments access the fund • The fund can be used to implement the following projects: forecasting and EWS, institutional development for local governments for preventive measures such as contingency planning for floods, guarantee risk insurance needs for farmers, drills, vulnerability assessments, monitoring risk areas, and enforcing local ordinances and codes
National Framework Strategy on Climate Change for 2010 to 2022	CCC, 2010 http://www.officialgazette.gov.ph/2012/08/16/republic-act-no-10174/	Serves as the country's roadmap for climate change adaptation	• Underscores the need to conduct vulnerability assessments and use them as bases for response • Aims to enhance capacity to anticipate and address typhoons, floods, and landslides by developing better decision support tools, enhancing monitoring and forecasting infrastructure, and mainstreaming CCA and DRR in local development planning

Name of the Document	Reference	Description	Main Initiatives/Actions Highlighted
National Climate Change Action Plan for 2011 to 2028	CCC, 2011 http://climate.emb.gov.ph/wp-content/uploads/2016/06/NCCAP-1.pdf	Operationalizes the NSFCC by identifying strategic actions and priority areas	• Identifies human security as one of the seven priority areas. This covers plans to conduct risk and vulnerability assessments at the provincial level and mainstreaming climate concerns in local development plans • Another priority area is knowledge and capacity development. This covers plans to establish centres of excellence for climate modelling and forecasting and to integrate climate change in both basic and higher education. It likewise plans to improve early warning and disaster communications, including identifying and upscaling indigenous EWS
A Guide to Comprehensive Land Use Plan Preparation	Housing and Land Use Regulatory Board (HLURB), 2014 http://hlurb.gov.ph/services/local-government-unit/clup-guidebook/	Serves as reference for local governments in preparing and implementing their land use plans. Has three volumes that cover the planning, sectoral analysis, and zoning. There is also a supplemental guide for mainstream CCA/DRR in the CLUP	• Updated in 2014 to comply with RAs 9729 and 10121 (mainstreaming CCA and DRR, respectively) • Volume on sectoral analysis provides guidance on hazard assessment and mapping and coastal planning. It also includes questions that will help local governments assess their capacity for early warning, evacuation, and emergency response • The supplemental guidebook helps local governments assess and include climate and disaster risks in their land-use plans

This table lists all the policies, guidelines, national/local report available for MHEW in Coastal Resilience that are cited by the INTERVIEW RESPONDENTS and are not covered in the literature review:

Name of the Document	Reference	Description	Main Initiatives/Actions Highlighted
National Disaster Preparedness Plan (NDPP)	National Disaster Risk Reduction and Management Council, 2015 • Volume 1: https://lga.gov.ph/media/uploads/2/Publications%20PDF/Book/NDPP%20Vol%201.pdf • Volume 2: https://lga.gov.ph/media/uploads/2/Publications%20PDF/Book/NDPP%20Minimum%20Standards%20Vol%202.pdf	Serves as the main reference document for disaster preparedness for local government units (LGUs). Developed based on preparedness-related policies, agreements, laws, issuances, and plans (including NDRRMP) of the Philippine government.	Volume 1 • Narrates the country's exposure to the following hazards and lists the efforts of different agencies to map them: storms, typhoons, floods, storm surges, earthquakes, subsidence, landslides, and conflict • Summarizes the results of the assessment on the disaster preparedness of LGUs based on organizational structure, operational readiness, and presence of plans. Also lists policies and agreements (both international and local) relevant to disaster preparedness. • Articulates the disaster preparedness framework and delineates the roles of different government agencies and other stakeholders in each of the 7 preparedness dimensions: information, education, campaigns; capacity building; DRRM localization; risk assessment and plans; preparedness for emergency and disaster response; continuity of essential services; and partnerships

Name of the Document	Reference	Description	Main Initiatives/Actions Highlighted
			Volume 2 • Stipulates the minimum standards for disaster preparedness in terms of the following: organizational structure, principles and procedures for DRRM activities, plans, data, trainings, equipment, and services
National Disaster Response Plan	Office of Civil Defence, 2014 http://www.ndrrmc.gov.ph/attachments/article/1334/NDRP_Hydro_Meteorological_Hazards_as_of_2014.pdf	Serves as the main guide for local and national government agencies in responding to hydro-meteorological hazards. Response plans for seismic, tsunami, and volcanic hazards are currently being drafted.	• Mandates DRRMCs to align and follow this document when they formulate their respective response plans • Describes activities and delineates roles of different government agencies before, during, and after a disaster according to the following response clusters: food and non-food items; health; protection camp coordination and management; logistics; emergency telecommunications; education; search, rescue, and retrieval; and management of the dead • Assigns the Operations Center (OpCen), managed by the Office of Civil Defence, to coordinate the tasks of all the response clusters

---- End of Report ----