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

MYANMAR

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1. Executive Summary

Purpose of the National Report

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. It is focuses on a subject area and a world region not sufficiently addressed by projects already being funded under previous schemes. This report is a part of the project and tried to find out the current situation of MHEW and coastal resilience in Myanmar and find the capacity gap that need to fulfill in national context.

Summary of methodology

To understand the current situation of MHEW and coastal community resilience, literature surveys were made through internets web sites of related ministries and other open sources. Some literatures were directly derived from the ministries. To find out the gap between policy, law, order, regulation and actual implementation in practice, 14 individual interviews and 2 focus group interviews were conducted to stake holders who are highly involved in the MHEW and coastal community resilience process.

Summary of main findings

Myanmar coastal area is exposed to disaster such as cyclone, storm surge, flood and Tsunami. Since Indian Ocean Tsunami (2004) and Cyclone Nargis (2008), people become well aware of natural disaster and pay attention on MHEW.

Department of Hydrology and Meteorology is mainly responsible for gathering of information, analysis and forecasting of hazards for Myanmar and dissemination of this information to the end user was carried out by General Administration Department through its wide range of network.

Hazard assessment efforts are still in the early stage of development and it is necessary to use advanced technologies in data collection and investigation, need to update assessment methods and get experiences on hazard assessment.

Myanmar has been actively considered and followed the guideline and agreements laid down by the Sendai Framework, Paris Climate Change Agreement and Sustainable Development Goals in establishment of the MEHW. Government laid down polices and enacted laws and orders in accordance with above global initiative frameworks for coastal community resilience. However, its implementation is weak and effectiveness is difference based on the region and previous experience of disaster.

University will plays an important role for giving awareness to the public, nurturing scientist and conducting of MHEW related research. Although the roles and responsibilities of universities are clearly mentioned in the existing law and regulations, actual implementation is still very weak in practice.

Summary of main conclusions

Myanmar is making many efforts to improve MHEW and coastal community resilience in align with global initiative. Regional cooperation works are also found in this context. However, implementation and practicing of existing law and orders are varies based on the local context. Coordination between related ministries is weak. Participation of higher education institutions in MHEW is still low.

Summary of Recommendations

To establish effective MHEW system and contribute to the coastal community resilience, it is necessary to upgrade hazard forecasting equipment and technology, need to upgrade hazard information dissemination channels by using modern technology, need to widely give awareness to the public, need to reinforce existing infrastructures of coastal area and develop insurance system and post disaster recovering funding. In that case Higher Education Institution could play an important role by means of its human resource, knowledge, and international collaboration networks.

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 Myanmar.

3. Methodology

Literatures used in this report are derived from internet, relevant ministries and departments and other sources. Since it is country report it is mainly focused on the literature of Myanmar rather than regional one. Data used in this report are mainly derived from interviews of key personals involved in the disaster management process and education. Interviewees cover both from national to township level and government to public. Altogether 14 interviews and 2 discussions with related stakeholders (focus group) were conducted during July and August 2017. Since offices of some participants are located in capital city and regional area, some interviews were conducted in those areas.

Interviewees were selected based on purpose of the study. First interviewee group (5 interviews) comes from National Government Level and those are related to MHEW and disaster management. Second group is composed by professional government organizations those are actually dealing with MHEW (4 interviews). The third group (2 Interviews) is formed by local level interviewees who are practically involved in the disaster management and MHEW process. The last group (3 interviews) is composed of peoples who are involving in INGO working on MHEW and disaster management works in Myanmar.

Interviewees were informed about the project and content of interview questions at least two days before conducting interview. Voice recording was made with the permission of interviewee throughout the interview. Many interviews were made in Myanmar Language and translated into English Version for analysis.

Apart from above 14 interviews, two focus group discussions were also conducted. Focus group discussions were emphasized on their experience of disaster management, development of MHEW and coastal community resilience. Structured questioned are not used in that case.

Simple analysis methods were used to analyse the result of interview. In some cases, graphs and table were used to present the results.

Table 1: Participant Details

Participant Code	Level of experience in terms of involvement in MHEW in Coastal Resilience	Any other Remarks
MyIG 01	Have experience in managing disaster management training center training and educating people from various ministries	Hinthada Township, Ayeyarwady Region
MyIG02	Have experience in weather and disaster forecasting for a long time and involve in decision making level	Department of Meteorology and Hydrology

MyIA03	Responsible person for a university located in western coast of Myanmar where cyclone frequently pass through	Sittwe University, Ministry of Education
MyIA04	Responsible person for a university located in Southern coast of Myanmar where cyclone and Tsunami could strike	Myeik University, Ministry of Education
MyIG05	Have long experience in relief and settlement work of the governments	Relief and Resettlement Department, Ministry of Social Welfare, Relief and Resettlement
MyIG06	Working in the EOC where Vice-President chairs, manages and give decision in the situation of emergency	Emergency Operating Center, Relief and Resettlement Department, Ministry of Social Welfare, Relief and Resettlement
MyIG07	Well experience and giving training in disaster management and international collaboration	Disaster Management Section, Myanmar Red Cross Association (Head Office), Nay Pyi Taw
MyIN 08	Have experience in dealing with disaster risk reduction projects and Multi-Hazard Early Warning System	United Nations Human Settlements Programme, UNHABITAT, Myanmar
MyIA09	University academician and expert in the field of food hazard in Ayeyarwady Region where Severe Cyclone Nargis strike	Pathein University, Ministry of Education
MyIN10	Well experience and responsible in management of information related to Myanmar. Maps and other required data are all collected and support to the decision making process of the government	Myanmar Information Management Unit, UN-RCR, Myanmar
MyIL11	Key person involved in the disaster management team at township level. Have experience of Cyclone Nargis	General Administration Department, Laputta Township, Ayeyarwady Region
MyIL12	Well experience and responsible person in MHEW and coastal community resilience at Region Level	Ayeyarwady Region Relief and Resettlement Department, Ministry of Social Welfare, Relief and Resettlement
MyIN13	Have long experience in helping Myanmar with Climate Change and Risk Management and working at an INGO.	Climate Change and Climate Risk Management (CCCRM), Asian Disaster Preparedness Center, Bangkok
MyIA14	Have experience in earthquake related disasters in Myanmar, an also member of a Myanmar Earthquake Committee, a professional organization	Myanmar Earthquake Committee

MyFL15	Responsible person for security matters during disaster and peace and tranquility in normal situation	Police Force, Laputta Township
MyFL16	From Red Cross Society, well experience in disaster management. Also native person and have experience of Nargis	Red Cross Society, Laputta Township
MyFL17	Responsible person for Relief and Resettlement of the District and member of District Disaster Management Committees	Relief and Resettlement Department, Hinthada, District
MyFL18	From Red Cross Society, well experience in disaster management	Red Cross Society, Hinthada Township

4. Background

The Republic of the Union of Myanmar, located between latitudes 9°32' N & 28° 31' N and longitudes 92° 10'E & 101° 11'E, with a total area of 676,578 sq. kilometers, is the largest country in mainland Southeast Asia. It reaches about 2,051 kilometers (1275 miles) from north to south and 936 kilometers (581 miles) from east to west. Myanmar is surrounded by China in the north and northeast, the Lao PDR and Thailand in the east and southeast, India and Bangladesh in the west while the Bay of Bengal and the Andaman Sea are in the west and the south (NDPCC, 2009).

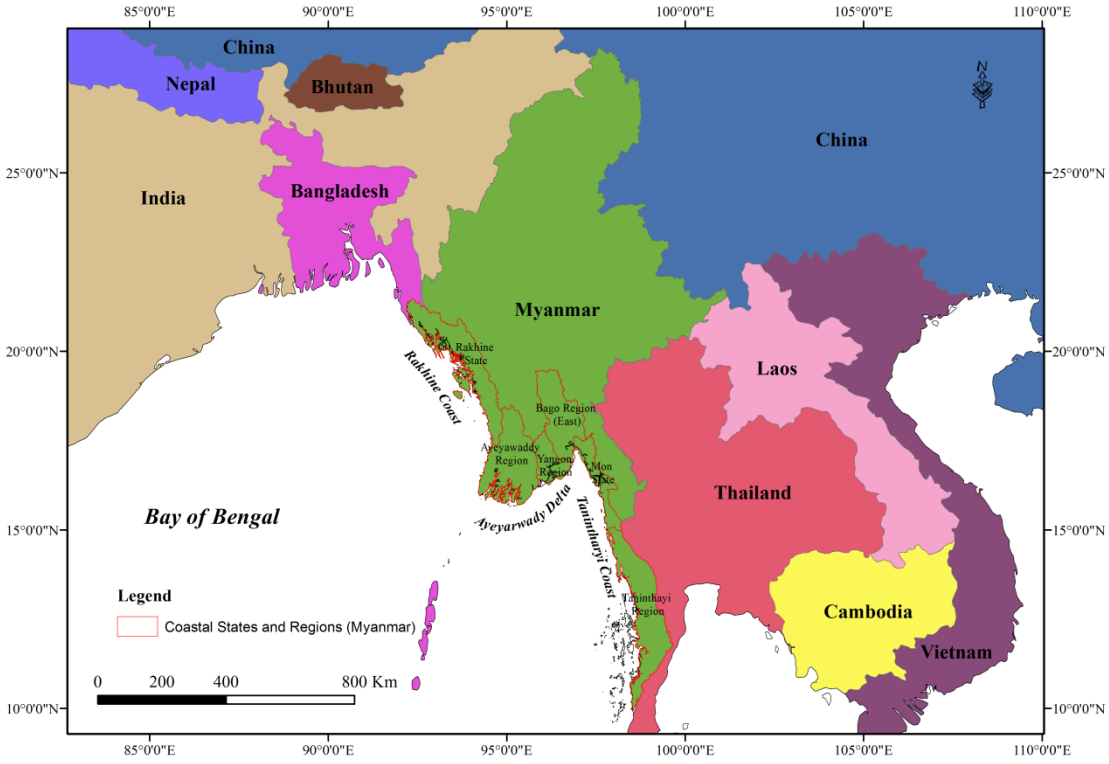

Figure (1) Coastal State and Regions in Myanmar
(Source: Department of Geography, University of Yangon)

According to 2014 population census, the total population of Myanmar is 51,486,253. Buddhism is the main religion and occupied about 89.8 % while Christianity and Islam share 6.3% and 2.3 % respectively (DoP, 2016).

The coast line of Myanmar is 2223 km (1385 miles) long, bordering the Bay of Bengal and the Andaman Sea. Although the coastal area is potentially rich with marine natural resources, it is also potentially threatened by waves, cyclones and associated weather. Since Myanmar is a tropical agricultural country, the majority of the people live in the fertile plain land which is often inundated by river floods and coastal areas exposed to stormy weather (RRD, 2009).

Myanmar coast line area could be divided into three parts: Rakhine Coastal Area in northwest, Ayeyarwady Delta in Southwest and Tanintharyi Coastal Area in the South (Figure 1). The coastal regions of Myanmar especially in the western coast and increasingly southern coast have exposed to tropical cyclone, storm surges (MSWRR, 2017) and Tsunami (RRD, 2012).

Among the coastal areas, Ayeyarwady Region and Rakhine State are prone to storm surge. However, the intensity of Tsunami and extent of the inundation was relatively lower than other countries during 2004 Indian Ocean Tsunami. Among the coastal area of Myanmar, Ayeyarwady Delta received slightly larger amplitudes from its shallow coastal topography (RRD, 2012).

Between 1980 and 2015, about 140,000 peoples lost their lives, the livelihoods of more than 5 million people were affected and total amount of physical lost counted to 5 billion US Dollar caused by the natural disasters in Myanmar (MSWRD, 2016).

5. Coastal Hazards

Myanmar is one of mainland Southeast ASEAN Countries. It is located in Indo-china peninsula. The Sagaing fault, which is an active large fault is passing through central lowland from south to north of the country (Pramumijoyo, 2010). Southern and southwestern parts of the country are the coastal regions and northern and northwestern portions are southeastern most edge Himalaya region (Krishnan, 1949). Consequently, the country is geo-tectonically and meteorologically exposed to variety of hazards such as floods, cyclones, storm surges, earthquakes, landslides, fires and Tsunamis. Over the decade, Myanmar has suffered from cyclones, floods, earthquakes, and landslides. Especially the coastal regions of the country are mostly affected by storm and its associated hazards.

Among the cyclones, Cyclone Nargis, the most devastating hazard event occurred in 2008, significantly damaged to a lot of lives and properties especially in the Ayeyarwady delta region. More than 80000 people died and thousands of families in Ayeyarwady coastal area were homeless due to Cyclone Nargis. In addition, many basic infrastructures were damaged and 21 million US dollars of the country' GDP were lost due to Cyclone Nargis (UNHABITAT, n.d. b). In 2010, the Cyclone Giri passed through Rakhine State in southwestern part of Myanmar. As a consequence, more than 259 people lost their lives and approximately 1 million people were affected. In 2015, Cyclone Komen hit also the Rakhine Coast in the southwest of Myanmar. Consequently, Rakhine State including Yangon Region, Magway Region, Mandalay Region, Sagaing Region fell within flood hazard while Chin State was existing in landslide hazard. The country also faced damage and loses of property and infrastructures due to Cyclone Komen in 2015. In 2016, Cyclone Roanu passed through southwestern states of Myanmar. It had caused several damages of homes in Chin State due to landslides (European Union, 2015). In 2017, Cyclone Mora also hit particularly the northern Rakhine State and affected it including Chin State, Ayeyarwady Region, Magway Region and Sagaing Region, respectively. Over 3000 households were affected in Rakhine State due to the Cyclone Mora (International Federation of Red Cross and Red Crescent Society, 2017).

The second most occurrence of hazard among hazards in Myanmar is flood. It can be simply classified by two types of flood such as riverine flood and flush flood. As the two third of the country is lied within Ayeyarwady river basin which is originated from northern most icebergs of the country. The central lowland area is frequently suffered by flush flood. In addition, most of the Ayeyarwady delta area and coastal region are always affected by riverine flood. On 30 July 2015, Cyclone Komen caused severe floods and landslides across 12 of the country's 14 states and regions (Ayeyarwady, Bago, Chin, Kachin, Kayin, Magway, Mandalay, Mon, Rakhine, Sagaing, Shan, Yangon), respectively (GoUM, 2015). According to the National Natural Disaster Management Committee (NNDMC), 125 people were killed and 1.7 million people were temporarily displaced by floods and landslides due to Cyclone Komen (UNHABITAT, n.d. b).

Myanmar rests on one of the world's two main earthquake belts, with one of its many fault lines running 1,000 km from north to south where not only central plain of the country is rich in agriculture and plains but also major Myanmar cities, including Mandalay, Bago and Yangon are built, at risk. During the 20th Century alone, at least 18 large earthquakes had happened along the Central Lowland region where the well-known Sagaing Fault passes through. The largest measured earthquake with 8.0 magnitudes in Myanmar occurred on the northern segment of this fault on 23 May 1912.

Myanmar indeed is earthquake-prone as it lies in one of the two principal earthquake belts of the World's Alpine-Himalaya Belt (AHA Centre, 2015). The historical and seismic records show that in addition to some major historical earthquakes in the distant past, there had been at least 16 large earthquakes with magnitude 7.0 within the territory of Myanmar in the past 170 years (AHA Centre, 2015). There were also records of moderate Tsunami generated by two large magnitude earthquakes, which originated in the Andaman- Nicobar Islands. Thus, it is evident that Myanmar is vulnerable to hazards from moderate to large Tsunami along its long coastline. In view of these events, it is necessary to assess the earthquake and Tsunami hazard potential along the Myanmar's coastal urbanized areas.

5.1 Impact of the Coastal Hazards

5.1.1 Literature Review findings

Myanmar has four geo-morphological regions such as Eastern Highland Region (known geologically as Shan-tanintharyi Block), Central Lowland Region (Central Cenozoic Belt), Western Fold Belt (Western Mountainous Region), and Rakhine Coastal Lowland Region (Rakhine Coastal Belt) (Pramumijoyo, 2010). Southern part of Myanmar falls in coastal zone and the coastal zone of Myanmar can be subdivided into three main areas, namely Rakhine Coast, Ayeyarwady Delta and Tanintharyi Coast. There are many rivers such as the "Mayu" and "Kaladan" rivers in the Rakhine Coastal area and the "Ayeyarwady", "Sittaung"and "Thanlwin" rivers in Ayeyarwady Delta area. The "Ye", "Dawai", "Tanintharyi" and "Lenya" rivers run in the Tanintharyi coastal area.

Due to geo-morphological and geological features, Myanmar has faced with multi-natural hazards such as Cyclones, Storm surges, Floods, Landslides, Earthquakes, Tsunami, Droughts, Fire and Forest Fire. Coastal Region of the country is mostly exposed to cyclone with heavy rain, storm surges and Tsunami. The rainfall-induced flood is a recurring phenomenon across the country while some parts of the country are exposed to landslide and drought risks. On the other hands, rainfall in the mountains and highlands causes the flood in the central lowland region (AHA Centre, 2015). As per data from 2000-2001 to 2009-2010, fires constituted about 73% of reported disaster events, followed by floods (11%), storms (12%) and others (4%) including earthquakes, Tsunami and landslides. The Global Climate Risk Index listed Myanmar as the second-most vulnerable to weather-related extreme event that occurred between 1995 and 2014. In addition, the tropical cyclone will continue to pose critical hazards due to their strong winds, heavy precipitation and costal

strong surge (Horton, et al., 2017). In 2008, the Cyclone Nargis occurred and it was the worst natural disaster in the living memory of Myanmar.

The coastal regions of Ayeyarwady Region and Rakhine State are especially prone to cyclone and storm surge. During Cyclone Nargis, 90 percent of deaths were caused due to direct consequence of the storm surge. In the last four decades, seven major cyclones hit Myanmar; 1968 (Sittwe cyclone), 1975 (Pathein cyclone), 1982 (Gwa cyclone), 1994 (Maundaw cyclone), 2006 (Mala cyclone), 2007 (Akash cyclone), 2008 (Nargis cyclone), 2010 (Cyclone Giri), 2015 (Cyclone Komen), 2016 (Roanu Cyclone), and 2017 (Mora Cyclone), respectively. The Sittwe cyclone led to a loss of 1037 lives, Pathein cyclone claimed 304 lives and Nargis which is the most devastating in the living memory of Myanmar, resulted in 84,537 deaths, 53,836 persons missing, affected 2.4 million population, and damage and loss of approximately 11.7 trillion Kyat (4.1 billion USD). The Cyclone Giri in 2010 also claimed loses of 58 lives (RRD, 2012).

The mostly occurred natural hazard in coastal area of Myanmar is flood. As the past documentation, floods led to loss of lives and properties, devastate to basic infrastructure, economic loss and out breaking of water related diseases. Myanmar receives practically all its rainfall between mid-May and October, during which flooding is common. The riverine floods are common in the river delta while the flash floods and landslides are frequent in upper reaches of the river systems, which are normally the mountainous areas. Localized floods also temporarily occur especially in cities and towns. The Ayeyarwady delta region sits open and vulnerable to storm surge as it is currently is home to 40 percent of Myanmar population and covered by paddy cultivated land (Horton, et al., 2017). In addition, Ayeyarwady delta area has a lot of dykes which was constructed during colonial period. These dykes cause the riverine flood for most of the residence and cultivated areas of rural areas because of shifting the river courses. Moreover, the collapse of river bank is also one of the major damages which have destroyed the settlement and economic activities in delta area.

Table 2: Impact of disaster on key development sectors in Myanmar

(Kyat in Million)

Development Sectors	Cyclone Nargis (2008)	Flood and Landslide (2015)
Agriculture, Livestock and Fisheries	571,000-694,000	713,217
Industry and Commerce	2,516,600	480,808
Housing	711,900	542,233
Education	116,300	50,772
Health	18,900	8,185
Total Damage and Loss as a Percentage of the GDP of the previous fiscal year	21	3.1

Source: MAPDRR, 2017.

Table (2) shows the impacts of two major disasters in Myanmar. It affects both social and economic sectors of Myanmar. Damage of Cyclone Nargis (2008) even reached the 21

percent of 2007 fiscal year GDP while flood and landslide occurred in 2015 destroyed about 3.1 percent of 2014 fiscal year GDP (MAPDRR, 2017).

5.1.2. Interview and Focus group findings

For this project, interviews with 14 interviewees from several sectors had been provided. Most of the interviewees accepted that Myanmar possessed the long coastal line in western part and the impact of coastal hazards are mostly affected in adjacent areas which can be identified in three parts such as Rakhine, Ayeyarwady and Taininthayi coastal areas. Especially, impacts of costal hazards affect on social and economic activities in those areas. Basically, the coastal disasters can be also identified in three types - namely meteorological, hydrological and geological disasters. The flood due to hydrological factors is the most frequent disaster in Ayeyarwady delta area. The cyclone also leads to the damages more than flood in this area.

The two interviewees (MyIG05 and MyIG06) said that due to topographic situation and good economic opportunities, people prefer Ayeyarwady delta to other two coastal areas such as Rakhine and Tanintharyi coastal areas in Myanmar. However, the Ayeyarwady delta which has good communication, good economic opportunities based on very fertile flood plain, is highly vulnerable to the riverine flood, storm surge and cyclone come from Bay of Bengal.

An interviewee (MyIG07) highlighted that in Ayeyarwady coastal area, the Cyclone Nargis occurred in 2008 led to huge impact on the coastal areas. The largest damages such as physical and socio-economic activities and infrastructures as well as mental impact in most local communities were observed in the country due to this Cyclone Nargis. And then, he explained that the second largest impact of the coastal hazard in Myanmar was Tsunami which was related to Sumatra Earthquake in Indonesia and occurred in December 24, 2004.

Most of the damages due to coastal hazard in Myanmar coastal areas had vastly impacted on social and economic environments of coastal communities. Those damages are closely related to the weakness of disaster preparedness or/and pre-disaster management.

Coastal areas are main sources of marine product and rice (in case of Ayeyarwady) and its products are distributed to the whole country. Coastal areas itself a big market for product produced for non-coastal part of the country. Socio-economic conditions of a country could be considered as a system. Therefore, disasters occurred in coastal areas directly impact on coastal area itself and indirectly impact on other areas of the country as a consequence.

5.2 Early Warning Systems available for Coastal Hazards

5.2.1 Literature Review findings

According to the country's census in 2014, most of 51 million of the Myanmar's population and its relative assets are concentrated in coastal and dry zone areas. These two physiographic regions are the mostly exposed to extreme weather events such as cyclones, storm surges, drought, etc. (Horton, et al., 2017). The government of Myanmar established Myanmar Action Plan on Disaster Risk Reduction (RRD, 2012). Multi Hazards Early Warning system of the country is based on 10 sub-components such as upgrade of existing early warning centre, multi hazards end-to-end warning dissemination system, improved meteorological observation and forecasting, enhanced flood monitoring and forecasting capacities at township level, landslide study and monitoring, drought study and monitoring, seismic monitoring, oceanic and Tsunami system, and forest fire and haze monitoring system.

The first component aims to upgrade the existing centers by instrumentation of and capacity building and the second one focuses on reducing the negative impacts of disasters through capacity building of at-risk communities to prepare for and mitigate disaster risk. The third is to improve the observation and forecasting capabilities and the fourth is to enhance the flood monitoring and forecasting capacity of township meteorology and hydrology officers and the DP communities. The fifth component lays on providing data and information on landslide hazard to the community at stake and the sixth on reducing the negative impacts of drought through effective drought monitoring. The seventh component is to reduce concise and timely cyclone and storm surge information. The eighth component and ninth component are to acquire more precise seismic data and to detect any abnormal fluctuations of the sea level for issuance of timely warming, respectively. The final component is to observe the forest fire and haze incidents and trends in the country (RRD, 2012).

For successful establishment of an early warning system in Myanmar, proper arrangements need to be made at national and sub-national levels down to grass-root level not just only in transmission of warnings but also in capturing the timely hazard information. A comprehensive early warning system usually consists of four key elements: (1) prior knowledge of the risks, (2) presence of a monitoring and warning service, (3) multi-layer information dissemination system, and (4) capacity to take timely actions (RRD, 2012).

The Department of Meteorology and Hydrology (DMH) is mainly responsible to provide the early warning system to higher authorities, local government, disaster risk reduction agencies, media, international NGOs, Myanmar NGOs, and public. In 2016, Myanmar received US$40 million from Japan to establish three weather radar stations in Yangon, Mandalay, and Kyaukphyu (a major town in Rakhine State in western Myanmar) as well as 30 automatic weather observation stations across the country in 2017. Among the natural hazards, the DMH can be able to provide the early warning system for cyclone and storm surge. The color coded cyclone warning message was started to use in 2009. In processing of early warning system to public, the DMH contributes to the warning information to higher authorities and local administrative bodies through the public by using the media and sharing the information. In order to improve the quality and accuracy of the weather forecast and early warning, DMH still needs to upgrade the capacity of equipment and tools for weather forecast. The DMH organizes Monsoon Forum as a mechanism for fostering a closer dialogue between forecast producers and users to enhance the uptake of weather and climate forecasts for disaster mitigation. RRD is also implementing the end-to-end early warning system project in collaboration with DMH, General Administrative Department, and JICA to enhance the capacity of the government and the community.

According to priority action 4.5 of MAPDRR (2017), end-to-end Multi-Hazard Early Warning systems will be improved, through strengthening of communication networks and early warning dissemination procedures and protocols under the leadership of Ministry of Post and Telecommunication.

Although the DMH has already provided the two Early Warning Center in Nay Pyi Taw and Yangon, the existing centers have to be enhanced with further instrumentation. Also the capacity building of the Early Warning Centers' staffs have to still be undertaken for further augmenting the interpretation and dissemination capacity. They are trying to promote the technical supports from international agencies such as ADPC, UNDMT, ESCAP and providing the upgrading process in hardware capacity as well as polishing their capacity development in augmenting the interpretation with RIME. Moreover, they can join with ongoing programme on Indian Ocean End-to-end Multi-Hazard Early Warning System of RIME as the international cooperation.

5.2.2 Interview and Focus group findings

The Multi-Hazard Early Warning system is available in Myanmar especially in coastal areas. In Myanmar, although EOC (Emergency Operating Center) has been already established with cooperation of MRC (Myanmar Red Cross Association), DMH and RRD, only one service provider for disaster information and disasters especially focusing on meteorological and hydrological disasters is the DMH. It is because this processing is mainly based on skills, modernized techniques, fine resolution data availability which can be able from international and regional cooperation. All answers of interviewees concerned with this condition are same with the above mentioned factor.

Most of the interviewee explained the delivering process of disaster-forecast information to public (local community of village level). The main source of information come from DMH

and the DMH officially send this focus information to decision level such as RRD, MRC and GAD of State and Region levels by using the communication of FAX, SSB and Phone message. And then, the responsibilities from GA, RRD and MRC distribute the early warning message to township level as well as to village level by using Phone's SMS and Social Media and handed-carries. Two or three interviewees from local GAD and RRD explained the importance of early warning information for local people. All of local people from coastal areas entirely depend on DMH information for saving their lives and socio-economic activities.

Before Cyclone Nargis, the processes of information and communication from DMH to Township levels and forecasting system in DMH were still in weakness. But, after Nargis, RRD setup the 30 Single Side Bands (SSB) in RRD offices of some townships. SSB is a type of modulation and it is used to transmit information, an auto signal by radio waves. It is a refinement of amplitude modulation which uses transmitter power and band width more efficiently.

Today, many people regardless of their age and rural or urban are using Facebook as their main source of information. However, using of social media to deliver the early warning information to village tract levels could confuse the official information from DMH with other information from social media. Therefore, the communication platform is stand in leading role on MHEW system for coastal hazard of Myanmar coastal areas. Moreover, Emergency Response Center makes preparation before the disaster. They have workshop with NGO, INGOs, and with administrators at every decision level.

6. Multi-Hazard Assessments

6.1.1 Literature Review findings

The multi-hazard assessments and hazard mappings have been carried out through cooperative works between government departments such as DRR and DMH, and international organizations such as UNOCHA, MIMU and some INGOs. Although there is the right ways that the hazard assessments should be provided after natural disasters, they can provide only disaster assessment reports for large scale disasters such as Cyclone Nargis. But, some organizations like AHA Center and JICA have made efforts for multi-hazard assessment as a country report for natural disasters.

The Myanmar Information Management Unit under UNDP has always produced the hazard mappings and some assessments since Cyclone Nargis in 2008. They provided aids to the cyclone affected areas, flood affected areas and potential flood estimated areas with cooperation of an international organizations such as ADPC. They launched and supported their outcome hazard map and assessments to use in post disaster managements of government departments and other organizations. In 2011, multi-hazard risk assessment in Rakhine State of Myanmar was prepared by UNDP. This assessment was based on cyclone, storm surge, riverine flood, landslides, forest and rural fire, earthquake, and Tsunami hazards (UNICEF, 2015). The riverine flood mostly occurs in coastal and central lowland regions of Myanmar. In addition, for flood hazard occurring in 12 States and Regions of 2015, the MIMU can support their valuable outcome results in time, to flood affected areas, lists of the village tracts which were flooded, and flood prediction for DRR and all social communities.

Some seismic hazard maps were developed in collaboration with Myanmar professional societies with the support of donors. For example, Myanmar Engineer Society and Myanmar Geological Society, Earthquake Committee, and UNHABITAT have jointly developed hazard profiles at State and Region and city level (UNHABITAT, n.d. f).

DMH provided the Multi-Hazard Risk Assessment in Rakhine State in southwestern coastal part of Myanmar together with UN Habitat, UNDP and some INGOs in which they can reveal the multi hazard-prone areas in the State (UNDP, 2011a). This assessment includes earthquake, landslide, flood, Tsunami, cyclone and storm surge, and forest fire for both region and town (urban area) levels (UNDP,2011b).

In priority action 1.2 of MAPDDR (2018), National comprehensive multi-hazard probabilistic risk assessment will be made under the leadership of DMH. This action will (1) identify suitable methodology and scale for comprehensive multi-hazard probabilistic risk assessment in consultation with the Central coordination committee on risk assessment, (2) develop risk maps of appropriate scales, which can assist in policy decisions including resource allocation for response/relief and recovery, (3) consider climate change projections, (4) widely disseminate of risk information, (5) periodically update of the risk assessment.

6.1.2 Interview and Focus group findings

Multi-Hazard Assessment is the evaluation of damages, about the disaster preparedness compare to disaster event, data collection and systematic investigation within the disaster period and resilience level of public and government departments concerned after the disaster.

Among the interviewees for this project, some interviewees (seven persons) did not understand the real definition of Multi-Hazard Assessment and they confused the MHA with Risk Assessment.

Multi-Hazard Assessment can be only undertaken as the country report and overall assessment on natural disaster of specific areas. They are not able to operate the sector-wise assessment of each disaster. The international organizations like UNDE, JICA, and UNOCHA undertake the hazard assessment upon specific disaster with cooperation of DMH, RRD and MRC. UNDP, ADPC and MES provided the cooperation works as a Multi-Hazard Risk Assessment in the Rakhine State of Myanmar in 2011. In 2015, JICA undertook the Country Report of Myanmar concerned with Natural Disaster Risk Assessment (MyIN08).

But (MyIG02) pointed out that there is no systematic and well defined assessment upon specific disasters although some INGO and NGO are providing the hazard assessment by means of the country report. The coordination works like data collection, data investigation and evaluation upon event disaster management between government departments and INGO and NGO are still in weak. In 2016, the CSO (Central Statistics Organization) is implementing as a focal point to collect the relevant data from disaster event and post disaster conditions.

Emergency Response Center (ERC) afforded to distribute the updating information. They try to distribute the information in four ways such official website, mobile application data information, face book information, and transform information directly to Radio, TV etc.

MIMU has involved in hazard assessment by producing the disaster affected maps since the period of Cyclone Nargis. They can also produce the maps of flood affected area zone in flooding period in time. They launch these products by updating in their web site (MyIN12).

Moreover, some academic professionals from local universities are undertaking this hazard assessment periodically but they mostly emphasized this assessment on their subject orientations. Most of those researches cannot support to the necessary assessment for specific disasters (MyIA09). There is some gap between university and organizations which are working for the coastal disaster resilience mechanism and plans. One of interview from university suggested that any permission from authority of government or projects about disaster is required to participate in that.

Therefore, it can be said that there is no cooperation works for hazard assessment among the government department, INGO, NGO and universities although some of them have the capacity to do the hazard assessment. Nevertheless, modernized technologies in data

collection and investigation, updated assessment approaches and experiences to do the hazard assessment are still in weakness. The existing capacity is not enough to give training and/or consultancy on hazard assessment to other countries.

Moreover, the coastal communities in Myanmar are only relying on the early warning information from DMH. MHEW is essential need for local people in coastal areas to do the resilience upon natural hazards. But, data manipulation and data availability of DMH are still needed to upgrade and integrate with based line spatial data. For example, when the DMH launched the recurrent interval time for storm surge which generated from Tsunami, there is little gap between precision of their focus and reality. Although they can get the global current information relevant to Tsunami in time, they do not have bathymetric profiles of continental shelf of Myanmar coastal areas. Therefore, the communication platforms are still standing in leading role for effectiveness of MHEW system for coastal hazards in Myanmar.

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

7.1.1 Literature Review findings

Myanmar is exposed to multiple natural hazards which include cyclone, storm surge, floods, landslide, earthquake, Tsunami, drought, fire and forest fire. Thus, the country is still need to be fulfilled MHEW concerns with Global Initiatives. To implement the guideline and agreements laid down by the Sendai Framework, Paris Climate Change Agreement and Sustainable Development Goals as post-2015 global frameworks, the country has been trying to establish the MEHW to be a proper way of utilization and application but it is still need to be filled up the gap for further implementation (RRD, 2012).

For example, 7 components of Myanmar Action Plan for Disaster Risk Reduction (2012) has align with the five Hyogo Framework for Action (HFA) Priorities and with the Articles of the ASEAN Agreement on Disaster Management and Emergency Response (AADMER). Each component has 4 to 13 subcomponents/ projects and in total 65 priority projects have been identified (DDR, 2012).

Table 3: Comparison of MAPDRR (2012) with HFA and AADMER

Sr	Component	HFA Priorites	AADMER	No. of Project
1	Component 1: Policy, Institutional arrangements and further institutional development	Priority 1	Article 6, 10	4
2	Component 2: Hazard, vulnerability and risk assessment	Priority 2	Article 5	8
3	Component 3: Multi-hazard Early Warning Systems	Priority 2	Article 7	10
4	Component 4: Preparedness and Response Programs at National, State/Region, District and Township Level	Priority 5	Article 6, 8	10
5	Component 5: Mainstreaming of Disaster Risk Reduction into Development	Priority 4	Article 6	13
6	Component 6: Community based Disaster Preparedness and Risk Reduction	Crosscutting	Article 6, 7	9
7	Component 7: Public Awareness, Education and Training	Priority 3	Article 6, 7	11

Source: RRD (2012).

MAPDRR (2012) initiated in align with the global initiative frameworks of that time such as Hyogo Framework for Action and Articles of the ASEAN Agreement on Disaster Management and Emergency Response. Based on achievements of MAPDRR (2012), accumulated experience and changing global initiatives, Myanmar lunched a MAPDRR (2017) recently. In recent years, Myanmar has endorsed and committed to a number of new global and regional frameworks, plans and agreements related to disaster, climate and development. It includes the Sustainable Development Goals (SDGs), Sendai Framework for Disaster Risk Reduction, the Paris Agreement on Climate Change, the Asia Regional Plan for Implementation of the Sendai Framework for Disaster Risk Reduction and the AADMER Work Programme 2016-2020. Apart from that national economic policy of Myanmar which based on holistic development approach and requires a long-term systematic approach to include DRR into its development agenda.

Policy Document	MAPDRR 2017			
	Pillar 1	Pillar 2	Pillar 3	Pillar 4
Sendai Framework for DRR	Priority 1	Priority 2	Priority 3	Priority 4
Sustainable Development Goals	Goal 1, 3 and 13	Goal 1 and 11	Goal 1,2,3,4,6, 9,11,13 and 15	Goal 1,3,11 and 13
Paris Agreement of Climate Change	Annex, Article 8		Annex, Article 8	Annex, Article 8
Economic Policy of Myanamr			Policy Number 6 and 9	

Source: Derived from NDMC (2017).

Myanmar is involved in many relevant regional and international agreements related to community disaster resilience. Recently adopted “Myanmar national framework for community disaster resilience” also align with global initiatives of community resilience. Of them, Sustainable Development Goals which identify disaster risk reduction targets for four goals. These four goals include “end poverty in all its forms everywhere (Goal 1)”, “end hunger, achieve food security and improved nutrition, and promote sustainable agriculture (Goal 2)”, “make cities and human settlements inclusive, safe, resilient and sustainable (Goal 11)”, and “make urgent action to combat climate change and its impacts (Goal 13)” (MSWRR, 2017).

Sendai Framework for Disaster Risk Reduction (2015–2030) which prioritizes strengthening the resilience of communities and the need to work in partnership with civil society, community-based organizations, and volunteer organizations.

The Paris Agreement adopted at the 21st Session of the Conference of the Parties which recognizes the need to strengthen community resilience and undertake climate change adaptation options that take into consideration vulnerable groups, communities, and ecosystems.

The Association of Southeast Asian Nations (ASEAN) Agreement on Disaster Management and Emergency Response which calls for the involvement of local communities, NGOs, and private enterprises in disaster risk reduction activities (MSWRR, 2017).

7.1.2 Interview and Focus group findings

From focus group interviews, all interviewees stated that the implementations of MHEW and community resilience have been done in accordance with the post-2015 global frameworks. However, many of them could not give detail answer. Two interviewers pointed out the current status of MHEW implementations more detail. In Myanmar, the rules and regulations are laid down by national and international organizations referring to global concern. Then, training programmes for the people have undertaken for years. However, practical purpose drill has been carried out for small portions of the programme compare to other MHEW well-established countries.

Disaster Management Committee of Myanmar is chaired by the Vice-President and all implementations are made in accordance with the directives from the central body. All interviewees answered DMH as a primary responsible department of MHEW related data processing and analysis. They pointed that DMH assessing the information and transfer it to Relief and Resettlement Department for the action plan of disaster preparedness.

The most responsible body to implement MHEW and community resilience is government. General Administration Departments is formed at various levels. Thus, GAD is the most responsible for implementing MHEW and it is necessary to collect local context of disaster information since disaster occurs in one area is different from others.

The interviewees from government sectors said that to increase disaster resilience among coastal communities, the government is responsible whilst the people living in the coastal regions and coastal communities also need to participate in various aspects. In addition, NGOs and INGOs will join and support the government organization and peoples from coastal communities.

For the national level, there is an integration and cooperation between DMH and RRD to implement global initiative. All countries which have coastal areas are relatively richer than the countries those are land locked because the coastal area are rich in natural resources. By the proper management of coastal areas in the long term, the sustainable development of the region can be achieved (MyIG02). Thus, all of the interviewees agree that the inclusiveness of the coastal area and coastal communities is very important. Therefore, the upgrading of MHEW should be jointly done by civil society organizations, governmental organizations and ASEAN and international level experts.

Interviewees from local areas answer that the Information and Communication Department sends the information to respective regional government in which regional level disaster management committee has being established. The regional disaster management committee consists all of the officials in the regional level and do exercises together for Tsunami warning, conducting drills especially in the Tanninthary, Ayeyarwaddy and Rakhine regions. Moreover, chairperson for regional level disaster management committee is

chaired by regional commander of military command who conduct and implement the directives from the national level disaster management committee to the disaster happening area.

Interviewee from DMH answer that the DMH is making efforts to disseminate the information for real time announcement and distribution and it must be fast, true and accurate warning to the peoples. The daily focus on warning system is go central, regional, township, and village finally to communities, simultaneously the announcement can reach each and every area at the same time by the broadcast and peoples are doing in integration.

The interviewees from international and government organizations answered the questions concerns with MHEW and disaster resilience among coastal communities, for those all of the departments concerns are responsible from the disaster management committee to responsible for Myanmar. Therefore, the warning started from DMH should be aware by all of the peoples and need to work together RRD, GA and village development committee. One of the defect should be answered is the information missing between announcing department and receiving end.

The country is a disaster prone country and has suffered very diverse nature of natural hazards. To implement the global initiatives, it is needed to fulfill the capacity and capability of the coastal community and save their lives and properties in time, the systematic and advanced technological early warning system must be established by which the global initiatives could be fulfilled. Moreover, the establishment of coastal community resilience aims to the people who are potential to disaster whose participation to the implementation of MHEWS in all inclusive frameworks.

8. Current National efforts towards MHEW in Coastal Resilience

8.1.1 Literature Review findings

The aim of an early warning system is to alert the population under threat (of an imminent disaster) in time. There are four key elements in a comprehensive early warning system: (1) prior knowledge of the risks, (2) presence of a monitoring and warning service, (3) multi-layer information dissemination system, and (4) capacity to take timely actions. The four components are equally important because one should not be missed or fail in the implementation, if it is the whole system will not be achieved.

The Myanmar Action Plan on Disaster Risk Reduction (2017) has four pillars which are aligned with four priority actions of the Sendai Framework for Disaster Risk Reduction. Each pillar has six to nine priority actions. Each priority action has objectives and several indicative activities. In addition, each priority has its own lead department (s). Some priority actions such as Priority Action 1.8 (nation-wide disaster awareness programme with focus on people at most risk), Priority Action 4.1 (updating/ developing multi-hazard disaster risk management plans of all regions/ states, self-administered zones, districts townships and wards/ village tracts) and Priority Action 4.5 (improving end-to-end multi-hazard early warning systems, through strengthening of communication networks and early warning dissemination procedures and protocols) are closely related to Multi-Hazard Early Warning system of Myanmar (NDMC, 2017).

Indicative activities of Priority Action 1.8 are: (1) to organize Tsunami awareness day on 5 November and International Disaster Risk Reduction Day (IDRRD) on 13 October at the national, regional and state level, (2) to prepare an event calendar in advance and activities can include: seminar/ workshop, Special Meeting of the NDMC, DM bodies at subnational levels, activities in school, display of do's and don'ts at public places, radio and TV, newspaper, etc., (3) to hold IDRRD focus on sub-national level and local hazards, especially lightning in vulnerable regions and states, (4) to encourage youth volunteers of Myanmar to engaged in undertaking mass awareness activities at the local level, (5) to develop training packages on do's and don'ts related to various disasters specific to type of disability, (6) to conduct training for care givers from government and NGOs to train on usage of the package, (7) to create mass awareness on do's and don'ts related to disasters among communities, with a focus on people at most risk including PWDs, their family and neighbors, (8) to prioritize townships with large populations of PWDs and at who are at high risk. This priority action will lead by two departments and Department of Social Welfare will lead for PWD and Relief and Resettlement Department will lead for nation-wide awareness. Other department and universities such as General Administration Department, Ministry of Education, Ministry of Hotel and Tourism, Ministry of Border Affairs, Myanmar Radio and Television (MRTV), etc. will also participate in this process.

Priority Action 4.1 of MAPDRR 2017 has following targeted activities-

(1) Develop a short guidance notes along with disaster risk management plans to outline for regional/state, self-administered zone township and ward/village tract
(2) Guidelines on township disaster risk management plans shall be updated before the revision of the Township Disaster Risk Management (DRM) Plan
(3) Guidance on ward/village tract DRM Plan
(4) Capacity building of stakeholders on DRM plan development
(5) Development/updating of DRM Plans in a phased manner
(6) DRM Plan will be based on the risk profile of the regions/state, self-administered zone, district, township and ward/village tract.
(7) Develop guidelines on how to conduct mock drills
(8) Mock drills to test DRM Plan and review/update plans based on findings of the mock drills.

This priority action will lead by Regional and State Government and General Administration Department. DMH, RRD, ECD, Ministry of Border Affairs, Yangon University, Yangon Technology University and other universities will participate as the partners.

Priority action 4.5 intends to reduce the negative impacts of disasters through the dissemination of early warning information and signals in a timely and effective manner to sub-national authorities and communities. Indicative activities of this action include-

(1) review existing communication networks and identify locations, which require strengthening of communication facilities,
(2) offer incentives for private sector to provide communication services in locations, currently not covered or have limited coverage,
(3) identify alternative communication network/all-weather communication and cover Myanmar in a phased manner,
(4) develop early warning dissemination frameworks and institutionalized inter-agency arrangements and coordination mechanisms for better information flow,
(5) early warning through MRTV to include sign language for people with disabilities,
(6) formalize early warning dissemination arrangements at all levels,
(7) capacity building of local authorities on understanding early warning signals and actions,
(8) awareness generation on early warning and related actions, including evacuation efforts for communities.

This action plan will lead by Post and Telecommunications Department and other partner departments will include DMH, MRTV, GAD, Myanmar Police Force, RRD, UN Habitat, Private companies.

Upgrading of Existing Early Warning Centers is mainly focused by The Department of Meteorology and Hydrology (DMH) which has two Early Warning Centers, one each in Yangon and Nay Pyi Taw. It will seek technical support from international agencies such as ADPC, UNDMT and ESCAP; particular linkage would be made with the ongoing RIMES's programme on 'Indian Ocean End-to-end Multi Hazard Early Warning System'.

8.1.2 Interview and Focus group findings

Currently, the MHEW system is implementing from ministerial level to regional and local levels in practical ways. Department of Meteorology and Hydrology collects, analyses, interprets and directly disseminates disaster information to ministry, regional and sometime to district levels government departments. Many ministries and INGOs such as Ministry of Social Welfare, Relief and Resettlement, Myanmar Red Cross Society have their own offices and networks up to district level. These ministries and organizations also disseminate information throughout their network. Some ministries such as General Administration Department (GAD) have reached their networks and offices up to village level. In addition, disaster management committees lead by GAD have been formed at all level of administration. Disaster management committee is usually formed by related government departments, Fire Brigade, Red Cross Association, and local police force, etc. Therefore, GAD plays the most important role in dissemination of disaster related information in Myanmar.

Although many interviewees, especially from disaster prone area, know well about this s information transmission structure and establishment of disaster management committee, other interviewees do not even notice it.

Most of the Interviewees especially from government organizations answered that the country doesn't have enough capacity for MHEW. It needs to jointly build capacity of MHEW by means of cooperation among foreign organizations, domestic organizations and participation of all stakeholders. Then, it must be established a system for the MEHW for the improving coastal community resilience and all related ministries must be included in it.

All interviewees suggested that the information giving to the coastal communities must be clear enough to understand what the information means. Sometimes, the responsible persons in the target area have to translate the information to understand easily by the people in the shortest time to a grass-root level of potential hazard areas. Therefore, ethnic dialect should be taken awareness in Emergency Operation Centre.

Current national effort to the multi-hazard early warning system is ongoing process and needs to develop further by using advanced technology. National capability is need to build for the development of MHEW and local communities should get a quick access to the related information in a real time. The following steps need to be done for establishing the Multi-hazard Early Warning Systems such as upgrading of existing early warning centers, improvement of multi-hazard end-to-end early warning dissemination system, improvement of metrological observation and forecasting, enhanced flood monitoring and forecasting capacities at township level, and all the monitoring systems.

9. Policies to improve MHEW in Coastal Resilience

9.1.1 Literature Review findings

Myanmar is prone to coastal hazards like cyclone and flood. It was severely impacted by disasters in the past which included Cyclone Nargis of 2008 and Cyclone Giri of 2010. Therefore, the Government of the Republic of the Union of Myanmar has formulated the following policy and legal frameworks in line with global initiative frameworks to improve MHEW for coastal resilience.

1) Standing Order on Natural Disaster Management (finalized in January 2009 and updated in 2011) (NDPCC, 2009)
2) Myanmar Action plan on Disaster Risk Reduction (established in August 2009 and updated in 2012) (RRD, 2012)
3) Natural Disaster Management (DM) Law (ratified on July 2013) (GoUM, 2013)
4) Myanmar National Framework for Community Disaster Resilience (2017) (MSWRR, 2017)

Standing Order on Natural Disaster Management

The Standing Order on Natural Disaster Management in Myanmar is a key document defining the mandate, roles and responsibilities for national level institutions in disaster management. The Standing Order was created post the devastation caused by Cyclone Nargis. It reflects on lessons from the disaster response effort during Cyclone Nargis and includes actions to be taken by government agencies in the course of future disasters. It also guides the formation of committees and coordination mechanisms for a timely and coordinated disaster response (NDPCC, 2009).

The Standing Order notes that measures should be in place to make use of the assistance provided by the Armed Forces (army, navy, and air force) in addition to that provided by local volunteers and volunteers from other areas. It also refers to the role of the armed forces in expediting search and rescue activities, protection and other disaster relief efforts. The responsibilities of the Ministry of Defense and armed forces are delineated according to four disaster phases: Normal Times, Alert and Warning, During Disaster, and Relief and Rehabilitation. It has been noted that steps are currently underway in-country to update the Standing Order based on the changing context in accordance with the new Disaster Management Law and Rules established under the law and the Sendai Framework (CE-DMHA, 2017).

Myanmar Action Plan on Disaster Risk Reduction

For Disaster Risk Reduction as a National Priority, Myanmar endorsed Hyogo Framework for Action (HFA) which is the outcome Disaster Reduction Guideline for the next decades and participated by nearly 4000 delegates from 168 countries. Moreover, Myanmar had adopted ASEAN Agreement on Disaster Management and Emergency Response (AADMER) in July 2005. In order to implement HFA and AADMER, the Ministry of Social Welfare, Relief

and Resettlement, the focal Ministry for Disaster Management in Myanmar, developed Myanmar Action Plan on Disaster Risk Reduction (MAPDRR) (2009-2015) through consultative and partnership approach. The MAPDRR sets the importance of MHEW with the goal to alert the population under threat (of an imminent disaster) in time so that they can take timely protective actions. It provides a framework for multi-stakeholder engagements in Disaster Risk Reduction (RRD, 2012).

MAPDRR has attached high priority to community-based disaster preparedness and risk reduction. Among others, the action plan identifies the need for strengthening the policy environment, scaling up implementation through local development, promoting volunteerism, and establishing financing mechanisms for community-level disaster risk reduction measures (MSWRR, 2017).

MAPDRR (2017) includes four pillars and each pillar has six to nine priority actions. The four pillars are aligned with four priority actions of the Sendai Framework for Disaster Risk Reduction. Some of these priority such as improvement of end-to-end Multi-Hazard Early Warning systems (Priority Action 4.5) lead by Ministry of Communication, National comprehensive multi-hazard probabilistic risk assessment (Priority Action 1.2) made by DMH, and Tsunami, Floods, Cyclone and Storm Surge risk assessment of Ayeyarwady Region and Rakhine State (Priority Action 1.5) lead by DMH are closely related to MHEW (NDMC, 2017).

Natural Disaster Management Law

The principle national law guiding disaster management in Myanmar is the Natural Disaster Management Law, ratified on 31st of July 2013 in line with priorities established in the Myanmar Action Plan on Disaster Risk Reduction. Its objectives are to a) implement Natural Disaster Management Programmes systematically and expeditiously; b) form the National Committee and local bodies responsible for implementing Natural Disaster Management programmes, c) coordinate with national and international actors in carrying out Natural Disaster Management activities, d) conserve and restore the environment affected by natural disasters, and e) provide health, education, social and livelihood programmes to provide better living conditions for victims (GoUM, 2013).

Important provisions in the law with respect to early warning systems are as follows:

- Relevant Duties and Powers of the Natural Disaster Management Committee: a) establishing a Natural Disaster Management Center for monitoring and screening information relating to disasters and prompt dissemination of early warnings, b) coordinating with relevant local authorities and organizations for the timely evacuation of the population when early warning is received, c) taking necessary measures for emergency response including search and rescue, rehabilitation and reconstruction, and long-term protection against natural disaster.
- Duties and Powers of the Natural Disaster Management Bodies of the State or Region Governments in relation to Early Warning System: a) monitoring the potential for natural disasters and submitting information on imminent hazards to the National Disaster Preparedness Central Committee promptly, b) implementing emergency

responses promptly to reduce damage and losses, and c) directing the local population to leave at-risk areas and making arrangements for evacuation.

- Preparatory measures for Disaster Risk Reduction: a) carrying out improvements on EWS, b) identifying where natural disaster is likely to strike and preparing the natural disaster risk assessment and planning emergency management, c) increasing public awareness of natural disasters, d) providing guidance and promoting active participation in community-based Natural Disaster Management and Disaster Risk Reduction activities, and e) issuing early warning information to the public (Malteser International, 2013).

The Disaster Management Law also includes provisions on requesting assistance from the Armed Forces for search and rescue operations, security in disaster-affected areas and for the delivery of assistance to victims more generally. It also provides for the cooperation and liaison with foreign countries and other regional and international actors when assistance is required to expedite a response (GoUM, 2013).

Myanmar National Framework for Community Disaster Resilience

The Myanmar National Framework for Community Disaster Resilience was published in 2017. The framework was prepared by the Relief and Resettlement Department, Ministry of Social Welfare, Relief and Resettlement in close consultation with different ministries of the Republic of the Union of Myanmar, the Asian Development Bank (ADB), and the members of the Myanmar Disaster Risk Reduction Working Group. It seeks to achieve people-centered, inclusive, and sustainable socioeconomic development in the face of disasters triggered by natural hazards and climate change. The framework articulates a common understanding, proposes a coherent approach, and identifies potential opportunities for strengthening the resilience of communities in Myanmar. The recommended actions are community-based and span across key sectors such as rural and urban development, agriculture, environmental conservation and forestry, financial inclusion, social protection, and disaster preparedness. The implementation requires an inclusive approach, and leveraging partnerships and resource mobilization through the cooperation of government organizations, civil society organizations, the private sector, and development partners (MSWRR, 2017).

In addition, some townships, especially from disaster prone area have their own disaster management plan in documented form. It usually includes geographical background, hazard assessment, vulnerability assessments, forming of disaster management committee and their duty and rights when disasters happen (UNHABITAT, n.d. g).

9.1.2 Interview/Focus Group findings

Based on the interview with 14 stakeholders, 6 interviewees know that there are some laws and regulations related to hazards but they do not know exactly what these policies are all about. 8 interviewees do not know clearly if there are some policies or regulations related to hazards and MHEW in the country. One interviewee mentioned that the policies are at

the top level and they do not work well at local level. He also pointed out that the policies really demand very strict implementation.

However, effectiveness of the laws and regulations is clearly seen in Myanmar. Especially, it is more effective in the area where disasters frequently take place. One interviewee (MyIL11) from local level explained the situation of Cyclone Nargis and Post Nargis disaster response. During the Nargis, he was serving as an administrator in a town from Ayeyarwady Region. When he received the information of Nargis, he subsequently informed and ordered all fishing boats and passenger boats to move to a safer place although there is no well-laid plan and regulations to implement and practise at the time. He also asked one village that is located on an island near the sea to evacuate. Since there was no communication system and well-organized plan and guidelines for disaster response, he could not effectively inform the people in the area. Some of his colleagues blame him for threatening and upsetting the people. However, he informed the people to work in cooperation with Red-cross Association and the fire brigade that are two social organizations in the region. Since there was no law and regulation to support him at the time, it is risky for him to issue such an order. When Nargis struck the regions, many people who could not receive the information lost their lives. On the other hand, lives of many people could be saved due to his information.

But, at present, there are working committees for disaster preventions in all village tracts. It has well organized structures, plans, and assigned duties for disaster response in all village tracts. Due to their well- planned programmes and frequent drill events, people know how to and where to evacuate when a disaster occurs. Now, people have awareness through the lesson they got from Nargis and public awareness programmes and are ready to evacuate as soon as they receive the disaster information.

One person from a focus group discussion comparatively mentioned about the experience of Nargis and the last year's storm evacuation. He was a deputy head of Red Cross Association when Nargis struck Ayeyarwady Delta in 2008 (MyFL16). At the time, there was no systematic plan for disaster response although some civil social organizations have already existed. When Nargis struck their town, he and his colleagues came out and facilitated evacuation independently. Other people such as fire brigade members also came out at the same time. However, since there is no prior coordination and practice for disaster response, they have to discuss in the field and work together. Therefore, they could not effectively help the people. After Nargis, according to Disaster Management Law (2013) and other rule and regulations, every administration unit (from state level to village level) has to form Natural Disaster Management Committee led by General Administration Department and prepare and drill a plan for disaster response. Therefore, when the cyclone approached to their area, they announced the early warning and encouraged the residents to evacuate. Many villagers, especially from the low lying areas of the delta evacuated to the town where the authority designated as evacuation sites. This is due to enacting of law and practising of it in reality. It is said that even though the storm moved from the region, people do not dare to go back to their own region for two weeks.

The policies and plans for the disaster management and public awareness programme have been laid down just after the Cyclone Nargis and reinforced during the last 10 years. In addition, implementation plans are belong to various ministries and cover from state level to village level. Development of MHEW and coastal community resilience is also part of these efforts. However, level of implementation differs among the regions. Regions with past big disaster have focused by many NGOs, INGOs and government. Then, implementation level is high while others areas have little implication. Therefore, the standing order, plan and law should be implemented with strategies and need to be put into practice and tested through mock drills for further improvement.

10. Resilience Mechanisms

10.1.1 Literature Review findings

Myanmar is in the ongoing process of major social and economic reform to get decentralization, increasing openness, empowerment, inclusion, creating jobs, and improving the well- being of citizens especially those living in rural areas. It is understood that such reform will bring physical and social investment and could increase vulnerabilities if associated disaster risks are not considered in the development process.

Therefore, in Natural Disaster Management Law, disaster risk reduction was recognized as an underlying requirement for achieving sustainable development. It was called for integration of disaster risk considerations in development processes, establishment of government-led institutional setup at all levels of administration. In addition, it is also encouraged for close coordination between government, civil society groups, and other non-government organizations (NGOs) and international and regional organizations in carrying out Disaster Risk Management activities (MSWRR, 2017).

In 2012, Myanmar Action Plan on Disaster Risk Reduction was published as a roadmap for the implementation of disaster risk reduction priorities and it has attached high priority to community-based disaster preparedness and risk reduction. This action plan identifies the need for strengthening the policy environment, scaling up implementation through local development, promoting volunteerism, and establishing financing mechanisms for community-level disaster risk reduction measures (MSWRR, 2017).

Recently, efforts were made for the upgrading of MHEW and coastal community resilience infrastructure. Myanmar received US $40 million from Japan to establish three weather radar stations in Yangon, Mandalay, and Kyaukpyu as well as 30 automatic weather observation stations across the country by 2017. There was only one radar station which had not been operational since 1997 in the country when Cyclone Nargis struck in 2008 (CE-DMHA, 2017).

Weak infrastructure and poor housing conditions contribute to Myanmar's susceptibility. Many rural houses and schools are constructed with the aim of accommodating living and teaching activities. Although there is some public awareness event for the construction of low cost and strong housing, adoption of these hazard resilient features during their construction are not normally extensive. The structures may not be able to withstand strong wind and strong current of a cyclone. Therefore the communities are very much aware of the importance of cyclone shelters to protect their lives (UNHABITAT, n.d. a).

As a policy, Ministry of Social Welfare, Relief and Settlement asserted the following statement in Myanmar National Framework for Community Resilience.

"If improvements in the development sectors do not integrate disaster risk reduction, they could exacerbate existing disaster risk and create new forms of disaster risk. Building

disaster resilience in Myanmar becomes more important than ever to save lives, to protect investment and to ensure the sustainability of development gains." (MSWRR, 2017).

In order to reduce health risks to local communities associated with natural disasters, many measures have been implemented in Myanmar. The Department of Health raises awareness using newspapers, TV Spot and posters on the necessary precautions (appropriate behaviour changes) vulnerable communities should take to prevent health risks such as spread of water-borne diseases. Twenty national hospitals and 32 state and regional hospitals exist in Myanmar and these hospitals have been supported by the World Health Organisation (WHO) since 2006. The Department of Health (DoH) also provides local communities with pan and pipe sanitation systems for reducing outbreaks of water-borne diseases. Considerable investments have also been made to ensure water security for local communities (Delta Alliance, 2015).

Apart from above hardware community resilience measures, Relief and Resettlement Department devised a plan to better engage the community level by training youth volunteers to help disseminate information at the local level and assist the Relief and Resettlement Department officials by participating in community discussions that raise awareness on disasters. In addition, when a disaster occurs the trained youth volunteers will be able to help fellow community members in the immediate aftermath of a disaster, and they also have the task of building the community's capacity to take measures to mitigate the impact of future hazards (Don, 2015).

10.1.2 Interview and Focus group findings

Based on the interview with 14 stakeholders, all interviewees mentioned the investments on cyclone shelter and unavailability of insurance system for coastal resilience.

According to statistics derived from Ministry of Social Welfare, Relief and Resettlement, 93 cyclone shelters were constructed in Myanmar during 2008 and 2017. 25 more cyclone shelters were under construction and 70 cyclone shelters are planned to construct (Table 3). They are distributed in seven States and Regions. Among the coastal regions, the majority of cyclone shelters are located in Ayeyarwady Delta. Due to lowland topography and dense population, Ayeyarwady Delta is highly vulnerable for storm, storm surge and flood.

In Ayeyarwady Region, one cyclone shelter covers four villages. However, its purpose is for evacuation during the disaster and difficult to maintain the building regularly. Thus, it is more useful if they construct a strong building (to be used as shelter during the disaster) and then use it as primary school or monastery so that it could maintain the building and keep functioning through the year (MyIG1). One interviewee mentioned that the existing cyclone shelters are not so useful. Some of the shelters have been built where it is impossible to use them.

Table 3: Location of cyclone shelters in Myanmar (2017)

Sate/Region	Status			
	Completed	Under construction	Planned to construct	Total
Ayeyarwady	70	4	41	115
Rakhine	14	10	30	54
Yangon	9	0	0	9
Tanintharyi	0	3	0	3
Bago	0	5	0	5
Chin	0	1	3	4
Karen	0	2	0	2
Total	93	25	74	192

Note: Ayeyarwady, Rakhine, Yangon and Tanintharyi are located in coastal areas.
Source: Ministry of Social, Welfare, Relief and Resettlement.

Three interviewees mentioned that there are Improving and maintenance of embankments and polders in the Ayeyarwady and Yangon regions. One interviewee (MyIG05) pointed that Minister for Social Welfare, Relief and Resettlement frequently visits the places where disasters have occurred and assembled voices of the public, parliament members and local authority. Then, if necessary, to construct road or bridge in urgent to improve the resilience of the community, he tried to do it from his own ministry budget or by means of coordination with other related ministries. In addition, some job opportunities were created by the construction of a garment factory, etc. (MyIG05).

Concerned with soft resilience infrastructure such as insurance, all interviewees agree that it has not developed yet in Myanmar. By means of buying insurance to their belongings and business, people can quickly recover from disaster on their own accord with the money they get from an insurance company. However, this kind of arrangement is quite new for both the insurance company and people of Myanmar.

The government is seeking for more investments in disaster reduction, such as preparedness and preventions at the grassroots level of the communities to reduce the expenditure of the recovery sectors by working closely with UN agencies and the International Organizations such as UNDP, UNISDR, UNOCHA, Action Aid, UNHABITAT, IRC, ADPC, ADRC, etc.

In Myanmar, since most enterprises are still small- to medium-sized, they cannot afford to invest in disaster risk management and need further investment for sufficient financial capital (microcredit, commercial loans, cash grants and insurance), sustainable natural capital (fishery, mangrove and land) and human capital (vocational training, management of technologies, community level organizational skills for production and self-help).

Apart from it, some human resource trainings and toolkits related natural disaster management were developed and trained by government, NGO, INGO and UN organization in the disaster prone areas.

Generally, based on experience of the severe disasters during the last 2 decades, government and NGOs and civil social organizations make all-out efforts to sufficiently support hard resilience mechanism such as road, cyclone shelter, etc. Among the soft resilience mechanisms training and supports have been conducting in some areas. However, other soft resilience mechanisms such as insurance system, creation of job opportunities for local community resilience have not yet well developed in Myanmar.

11. Regional Cooperation

11.1.1 Literature Review findings

United Nations agencies and multilateral organizations cooperating in Myanmar for MHEW can be divided into four groups: UN agencies, international non-government organization, donors and regional and technical institutions (CE-DMHA, 2017).

There are four UN agencies working for disaster management in Myanmar. UNDP is working in risk assessment, early recovery, community based disaster risk management (CBDRM), disaster management institutional strengthening, and reconstruction. UNHABITAT involved in resilient urban development, shelter rehabilitation and reconstruction, earthquake risk assessment, mainstreaming disaster risk reduction (DRR) and CCA into sector development, disaster preparedness plans, capacity building and human resource development on DRR. UN Office for Coordination of Humanitarian Affairs (UNOCHA) is collaborating in coordination in disaster monitoring and response, disaster response preparedness and contingency planning. International Organization of Migration (IOM) involved in addressing the special needs of migrants in disaster preparedness and DRR.

INGOs involving in disaster management of Myanmar are ActionAid, World Vision, CARE, Malteser International, Save the Children, ACTED, SEEDS Asia, CWS, ACF, Plan, and OXFAM. They collaborate with the Ministries, and partner with local NGOs and serve as donors or act through project holders. They work in activities including hazard, vulnerability and capacity assessments, public awareness, supplying emergency response kits and warning dissemination equipment, and action planning at the village and township levels.

The biggest humanitarian aid donors are Japan, UK and Australia, and the European Commission Humanitarian Office (ECHO) in Myanmar. They operate in the contexts of their bilateral cooperation programmes with government and specific longer-term priorities articulated in country partnership strategies. Priorities vary among donors based on their interest. For example, ECHO prioritizes ‘people-centered’ preparedness measures while AusAID focuses on reducing vulnerability and enhanced resilience. Donors involved in supporting early warning projects are the World Bank, USAID, the EU, and the governments of Norway, Japan, Korea, Germany, the Netherlands, and Thailand.

Several type of regional and national technical Institutions are in Myanmar. ASEAN and the Bay of Bengal Initiative for Multi-Sectoral Technical and Economic Cooperation (BIMSTEC) are foreign regional organizations according to the National Disaster Management Law. Myanmar signed to the 1999 ASEAN Agreements on Trans-Boundary Haze Pollution Control. It is also a member of ASEAN Committee on Disaster Management (ACDM) and participates in the implementation of the AADMER Work Programme and is co-lead for the Recovery Working Group. Myanmar is connected to the ASEAN Humanitarian Assistance Center (AHA Center), which has an operational disaster monitoring system. DMH cooperates closely with the Regional Integrated Multi HazardEarly Warning System (RIMES) and is a full member of the Asia Disaster Preparedness Center (ADPC) Governance Mechanism, the Regional

Consultative Committee on Disaster Management (RCC). Myanmar's DMH has sent staff on training with RIMES, ADPC and the AHA Center.

The ASEAN Agreement on Disaster Management and Emergency Response (AADMER) which was signed in July 2005 and entered into force in December 2009 is the culmination of ASEAN's work in building regional resilience to natural disasters. The AADMER is a legally binding agreement that commits ASEAN member states to promoting regional cooperation in reducing vulnerabilities to disaster risks and improving effective responses to natural disasters. It also obliges ASEAN member states to work together within the overall context of sustainable development. It has been noted that AADMER is the first of its kind globally (Reza, 2009). This agreement marks a shift in ASEAN's disaster management approach from reactive to proactive as it encompasses the whole disaster management cycle, incorporating provisions for disaster risk identification, monitoring and early warning, prevention and mitigation, preparedness and response, rehabilitation, technical cooperation and research, mechanisms for coordination, and simplified customs and immigration procedures (ASEAN, 2009, 2005). Since the signing of the AADMER in 2005, ASEAN has implemented measures stated in the agreement such as the formulation of standard operating procedures, training and capacity building, the establishment of a disaster information sharing and communication network, and the forming of a rapid assessment team (Reza, 2009).

11.1.2 Interview and Focus group findings

Eleven interviewees mentioned that there are regional level cooperation and partnership for MHEW and coastal community resilience. However, only six interviewees give the name of organizations that are involving in above process. Others answered that although there are collaborations for multi-hazard at the regional level they do not know the name of organization (Figure 2).

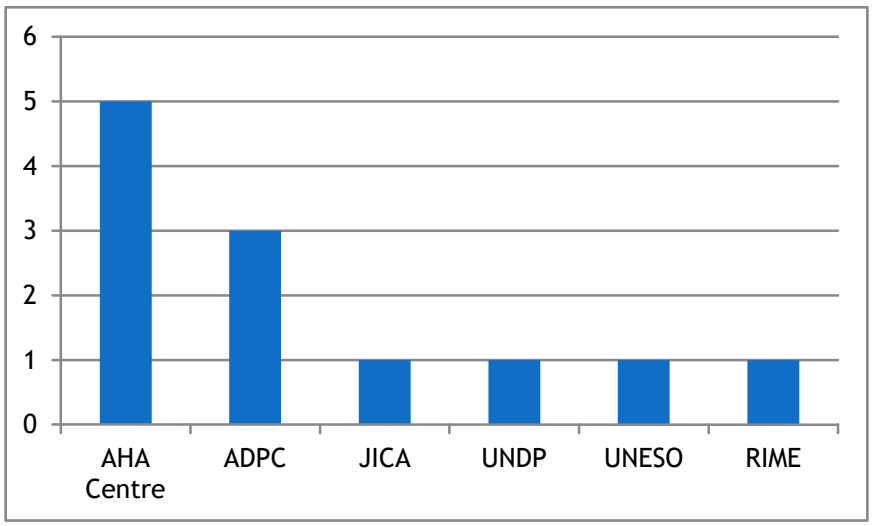

Figure (2) Regional cooperation partner for MHEW and coastal community resilience
Source: Authors' field interview.

There is regional cooperation with partner organizations from ASEAN especially ASEAN Humanitarian Assistance Centre (AHA Centre) located on Jakarta, Indonesia. AHA Centre always detects the situation of disaster (e.g earthquake, flood and storm) and generates message and warning to all the member countries. AHA Centre stores the (rescue) materials in Malaysia to help the disaster affected area. During Myanmar faced flood problem in 2005, AHA Centre came to Myanmar and helped the affected area (MyIG02). AHA Centre gives the training (2 persons per each country) for six months. Up to date, Myanmar has sent six trainees to AHA Centre (MyIG02). AHA Centre is also disaster monitoring centre and helps human resources, stocks and technology among ten ASEAN countries. ASEAN countries cooperate and help each other for the disaster protection and early warning system. Myanmar Information Management Unit has collaborated with AHA Centre and Asian Disaster Preparedness Center (APDC) for the software technology, applied in Typhon and cyclone (MyIN10). All the member countries pay for fees annually to AHA Centre to support the disaster affected region (MyIG05).

Another regional cooperation is Sentinel Asia, which is an international and intergovernmental institution located in Thailand. Sentinel provides Satellite data information and generate early warning system about storm or flood or earthquake to Department of Meteorology and Hydrology (DMH) and it generates warning to public (MyGI01). JICA has cooperated with DHM and setting up automated observation weather stations (radar) in Kyaukphyu, Yangon and Mandalay. DHM also has cooperated with UNESCO-IOC which is funded by International Oceanographic Commission and is global organization focus on Tsunami. UNDP has ongoing project and Rakhine State and Ayeyawaddy Division (MyIG02).

Regional Integrated Multi HazardEarly Warning System for Africa and Asia (RIMES) has collaborated with government sector and provided training, forum and technology for early warning system. RIMES focus on hazard monitoring, detection, analysis, prediction and forecasting (MyIG02). If the international organizations cooperate with other organizations, it is necessary to sign the MOU with government. After Nargis (2008), there are seven NGOs in Laputta and they are still working there with different objectives. Sometimes they may have same objectives but their implementation is different (MyIG11). Asian Disaster Preparedness Centre (ADPC) is a close collaboration with both Myanmar government and regional center which provide quite a lot of projects and different kinds of developments.

Indian Ocean Tsunami warning system initiated quite a lot of Tsunami problems with three mechanisms; (1) Indian Tsunami Warning System, (2) Multi-Hazard Regional Cooperation (RSMC) responsible organization for Bay of Bangle for this area and this zone and (3) IMT Regional Centre responsible for collaborative Myanmar, Bangladesh, Sri-Langka and Nepal (MyIN13).

After Nargis, DMH call for higher authority and forecast on the weather (disaster) for a year time before monsoon. After monsoon, they meet again in November as “Monsoon Forum” and evaluate the weather (disaster). If the outbreak is more than their forecast, they discuss the gap and find out the solution for the problems (MyIG02). After setting up the automatic observing weather station (radar), the image can check every 5 to 10 min. It increased the

ability of data acquisition. However, it is still need to enhance the capacity in analyzing of derived data. There will be necessary for training courses and capacity building. DMH doesn't have satellite so it has to depend on the message sent from others and it is the taking of the time. DMH still needs technical support to analyze the data information and training courses to staffs to operate the system (MyIG02).

During last decade, a lot of collaborations have been made between various ministry of Myanmar and regional partners for development of early warning and capacity building of community resilience. However, there are still need to improve in the area of infrastructure, technology and human resources development.

12. Enablers associated with MHEW in Coastal Resilience

12.1.1 Literature Review findings

A comprehensive early warning system usually consists of four key elements: (1) prior knowledge of the risks, (2) presence of a monitoring and warning service, (3) multi-layer information dissemination system, and (4) capacity to take timely actions. If one part fails, the entire system can collapse, resulting in innumerable damages (RRD, 2012).

For Multi - hazard Early Warning Systems, the MAPDRR (2012) has identified the following enablers, which align with the Hyogo Framework for Action (HFA) Priorities and with the Articles of the ASEAN Agreement on Disaster Management and Emergency Response (AADMER): upgrading of existing early warning center, multi-hazard end-to-end warning dissemination system, improved metrological observation and forecasting, enhanced flood monitoring and forecasting capacities at township level, landslide study and monitoring, drought study and monitoring, cyclone tracking and storm surge forecasts, seismic monitoring, oceanic and Tsunami monitoring system, forest fire and haze monitoring system (RRD, 2012).

Multi-Hazard Early Warning system should be included in broad range of hazards such as flood, landslide, cyclone and its storm surge, Tsunami, draught, forest fire, etc. With modern technology it is necessary to observe conditions, forecast and determine the possibility of extreme event, and timely dissemination the information to targeted population is an important process of an early warning system. In addition, early warning needs to be adapted to the specific need of at-risk communities such as difference in needs of women, elderly, disabled people, etc. The information must be disseminated in accessible ways and needs to be understood by the community. An early warning system has to be recognized as being able to support decision making and results in beneficial outcomes. In that case end-to-end people centered early warning system is important to protect people's lives and properties, encompassing risk knowledge, warning service, dissemination and response capacity (Malteser International, 2013).

In Myanmar, Department of Meteorology and Hydrology is responsible for monitoring, forecasting, and warning for severe weather, hydrological, and seismic events. Apart from them, various departments have their own observation stations. The National Multi-Hazard Early Warning Center located in the Department of Meteorology and Hydrology is supported by the Emergency Operation Center located in the Department of Relief and Resettlement with real-time hazard information collected from regional and global networks.

Warnings are shared with national print media and electronic media as well as with the state and regional governments. The state or regional government informs the Township General Administration Department to disseminate the warning to the communities

through administrative channels. Therefore, improving the system would include collecting reliable information and strengthening the communication channels between the Department of Meteorology and Hydrology, related ministries, and the General Administration Department. Communication channels from the General Administration Department down to the state, region, township, village tract, and village levels could be strengthened, including use of mobile phones and social media.

Partnerships or cooperation between agencies involved in data collection also needs to be improved. Weather and climate-related data collected by different government agencies should be shared for the benefit of the country's weather and climate services system.

In 2014, the Department of Relief and Resettlement launched the Disaster Risk Youth Volunteer Programme. Volunteers are expected to raise disaster awareness at the community level, improve community knowledge and the early warning system, act as first responders as well as act as the operational arm of township disaster management committees to connect the community with external agencies and partners, and contribute to response and recovery activities (Malteser International, 2013).

For successful establishment of an early warning system in Myanmar, proper arrangements need to be made at national and sub-national levels down to grass-root level not just in transmission of warnings but also in capturing the timely hazard information (RRD, 2012).

12.1.2 Interview and Focus group findings

Asian Disaster Preparedness Centre (ADPC) suggested three important factors: multi-stakeholders engagements, targeted focus on coastal recourses, in cooperation of resilience frame work and education and knowledge dissemination are also important factors for effective Multi-Hazard Early Warning system in coastal communities. Five points of factors are most important for effective MHEW system in coastal communities. These are (1) the warning message needs to reach to the target area effectively; (2) it is necessary to be able to understand the warning; (3) it is important to understand how to implement the early warning; (4) to practice the prior awareness to follow the early warning and (5) the warning should be clear to the administrative unit to facilitate in their management for effective early warning system.

The interviewees mentioned that both hardware and software necessity are important factors for effective MHEW in coastal communities. The necessity of having device for telecommunication is one of the important factors; media, phone device, electricity and loud speaker for generating warning to public within a short period. Everybody or every family from coastal area should be provided with hardware (radio). The user should know the value of those materials and understand how to operate it.

The public should be educated about early warning system. At present, the use of GIS, smart phone and internet access are quite effective in public. Although internet is the best effective way to know the warning news in time, some areas may have problem with

internet connection. If there is no internet connection, they cannot have access to the news via Facebook. It is necessary to enhance capacity in all sectors (e.g. using computer for data entry and analysis). The electricity is important for using electronic communication devices. Loud speaker is widely used for early warning at village level. When the village head receives a warning, the whole village will be informed by loud speaker. Therefore, all villages should have loud speaker.

Public awareness is important software necessity for effective MHEW in coastal communities. If the government organizations understand the MHEW system well, it will be more effective in implementation of this system. The government and the public should understand it and work together to improve the early warning system. It is important and should be sustainable. It is necessary to be provided with technology and funding. The public should be interested in disaster outbreak problem and to follow the early warning system. However, it will take time.

Another important thing is to do correctly with good intension. If they do well, many people will help them and they will succeed in their work. At present, MHEW system reaches to grass root level and that is effective. If it is the real volunteers, it will achieve their goal in relief. Their trust, confidence and reliance are also important.

The cooperation among the related stakeholders is also important to successfully implement the MHEW because process of early warning system is passing through many stakeholders.

Another important factor is transportation and it should be easier access from one place to another. It is also important to increase the coastal community resilience to strengthen current implementing system in coordination with administration, public and stakeholders. Developing curriculum concerning early warning system should be included in basic education. The public should be educated to understand how much loss can be caused by disaster. It will encourage the public awareness as well as the effective MHEW system.

Nowadays, information technology is well developed. If we could use mobile technology for transferring of MHEW related information, it will be very effective. The emergency news sent on mobile phone is more effective and saved time between end-to-end uses. It will be necessary for the training courses on the use of software (smart phone, GIS, Excel), information technology and information management for effective early warning system and still needs technical support and training courses to make effective early warning system.

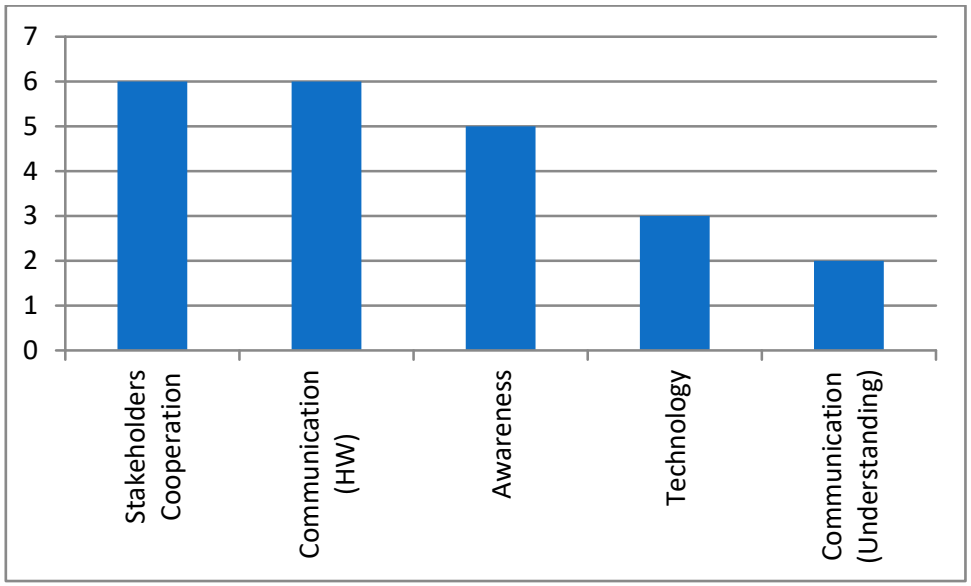

Figure (3) Enabler of MHEW for capacity building
Source: Authors' field survey.

Figure (3) shows the important enabler for MHEW capacity building mentioned by interviewees. Among them, cooperation among the stakeholder and improvement of communication (hardware) infrastructure such as Single Side Band (SSB), radio, loud speakers, etc. are most important for MHEW. Awareness is also essential enabler because it is necessary to have awareness to understand the derived information and to act properly based on derived information. It is also necessary to effectively use existing communication technology for MHEW. The last enabler is related to awareness of local community to the MHEW. It is necessary to fully understand derived information.

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

13.1.1 Literature Review findings

After the 2004 Indian Ocean Tsunami, the National Disaster Preparedness Central Committee was formed with a chairmanship of Prime Minister as a policy formulating body (CE-DMHA, 2017). After destruction of Tropical Cyclone Nargis in 2008, some natural disaster related education activities have been carried out with the collaboration of Ministry of Education and UN Agencies and NGOs. For example, ministry of Education and UNICEF has been collaborating in incorporating disaster risk reduction into school curriculum. UNDP and Ministry of Education have developed and distributed Resources Pack to community in Ayeyarwady and Mandalay Regions (RRD, 2012). UNHABITAT and Relief and Resettlement Department published manuals for disasters (UNHABITAT, n.d, b, c, d and e).

The "Standing Order for Natural Disaster Management in Myanmar" was issued by NDPC in 2009 to ensure that emergency relief and rehabilitation work are carried out according to the prepared plans and that the people are mobilised at the national level for participation in such efforts when the disaster strikes. In the standing order, the role of Ministry of Education for the education and awareness programmes were clearly stated as follow.

(1) to include disaster-related curricula at basic education schools, universities and degree colleges as required;

(2) to conduct drills and disaster-related educational talks on the nature of the disaster, preparedness for disaster-prone areas and disaster response at all levels in basic education schools, universities and degree colleges;

(3) to arrange educational talks for the general public on the disasters that the area where the school or university is located is vulnerable to;

(4) to conduct educational talks at all levels on environmental conservation activities that help prevent natural disasters (NDPCC, 2009, 111p.).

Myanmar Disaster Preparedness Agency (MDPA) chaired by Union Minister for Social Welfare, Relief and Resettlement (MSWRR) was formed with 13 members for disaster management. Under this Agency, Myanmar Disaster Preparedness Management Working Committee was formed by 11 members chaired by Deputy Minister of MSWRR. In that working committee, Director General for Department of Educational Training and Planning was a member (RRD, 2012, p4). In Myanmar Action Plan for Disaster Risk Reduction (RRD, 2012, p67), the plan of promoting the public awareness related to disaster management is clearly mentioned, based on the following eleven planned subcomponents.

(1) Awareness through Observed International Day Programme for Disaster Reduction on 13th October that is both United Nations' "International Day for Disaster

Reduction" and "ASEAN Day for Disaster Reduction". Through this programme prizes are awarded for the best risk reduction practice, essays, articles and painting competitions, drills and demonstration are conducted for the public.

(2) National Public Awareness Programme intends to develop 5-year public awareness programmes corresponding to the local hazard and risk by all regional and state disaster preparedness agencies.

(3) Awareness through School and School Curriculum Programme demands inclusion of disaster risk related lessons (basic cause and impacts of hazards) in primary education curriculum, and revise the risk relevant subject in Education College curriculum, with the collaboration of UNESCO, Ministry of Education develops learning kits and training for developing relief and emergency response plans for disaster risk reduction education.

(4) Awareness through University Curriculum Programme aims to create both awareness and research in university. It will be revised and materials will be developed for research and development in the area of disaster risk reduction.

(5) Expansion Plan for Disaster Management Training Programme was made by various ministries. Through this programme, disaster management trainings have been provided for government employees by Relief and Resettlement Department, Department of Health, Department of Traditional Medicine, Fire Service Department, Ministry of Education and other agencies.

(6) Training for Emergency Preparedness and Response at Township Level will focus on overall management and planning issues related to disaster risk reduction at township level. This course will include first aids, search and rescue, warehouse management and relief distribution.

(7) Enhancing Training Capacities Programme is a continuation of the above programme No. 5 and No.2. and Training for Trainer training related to disaster management will be carried out through this programme.

(8) Special Awareness Programme concentrates on preparing and publishing of materials on emerging issues such as climate change. Television series and radio talks will be organized to raise awareness on disaster risk reduction.

(9) Establishment of Disaster Management Training Center as a dedicated national level institution for technical support on disaster management to ministries, departments and other institution at region, state and below levels.

(10) Research and Development on Disaster Risk Reduction Programme will support the development of a national level research and development programme with a leadership of Ministry of Social Welfare, Relief and Resettlement.

(11) Regional Networking and Knowledge Sharing on Disaster Risk Reduction is a platform for information exchange on disaster risk reduction with ASEAN.

After the new government took power, National Disaster Management Agency chaired by the Union Minister for Social Welfare, Relief and Resettlement was formed in April 2011. Based on intensification of disaster and changing political situation, Natural Disaster Preparedness Central Committee was reformed with the chairmanship of Vice President in May 2013. It was abolished in March 29, 2016 and National Natural Disaster Management Central Committee lead by second Vice President was reformed by twelve Natural Disaster Management Working Committees in May 2016 (CE-DMHA, 2017).

In No.15 (b), Chapter VI (Natural Disaster Management), of Natural Disaster Management Law (2013), it is stated that "giving public awareness of knowledge of the natural disaster, keeping the early warning systems, training for search and rescue and making rehearsal". In no. 15(c), it is also stated that "enhancement of the capacity of the public for emergence of a disaster resilient community in compatible with climate change for reduction of damage and losses due to unforeseen disaster risk caused by climate change".

Therefore, the policies and plans for the disaster management and public awareness have been formulated just after the Cyclone Nargis and reinforced during the last 10 years. In addition, implementation plans belong to various ministries and cover from state level to village level. Development of MHEW and coastal community resilience is also part of these efforts.

13.1.2 Education and awareness programmes: Interview and Focus group findings

Interviewees were asked about the MHEW education and awareness programme for coastal hazard implementing in Myanmar. Out of 14 respondents, 9 answered that they have noticed MHEW education and coastal hazard awareness programmes. Three persons respond that there is no specific programme for MHEW education and coastal hazard awareness programme. Two interviewees who notice MHEW education and coastal hazard awareness programme pointed the works of UNDP and the efforts of the UN organization and the policy of MAPDRR as a policy for the public awareness programme. The rest (6) interviewees could not give exact answer for policy and programme related to MHEW.

Out of 14 interviewees, 10 answered the responsible department for MHEW education and coastal hazard awareness. Four answers pointed to Meteorology and Hydrology Department, three answers mentioned Department of Relief and Resettlement for this purpose. General Administration Department and all the government department is pointed as a responsible department by 2 respondents. MHEW of DMH and Emergency Operating Center received 1 response, each (Figure 4).

Interestingly, many answers pointed to the DMH who is responsible for the issuing of early warning system for hazard and the role of higher education institutions is missing in this aspect. DMH does not have many offices throughout the whole country. Department of Relief and Resettlement also has its office at the district level. Therefore, distribution of MHEW information was mainly made by General Administration Department which covers up to village level. Although it is possible to send information to all levels by means of today's social media and telephone message, General Administration Department plays an important role for giving public awareness and drilling up to village level.

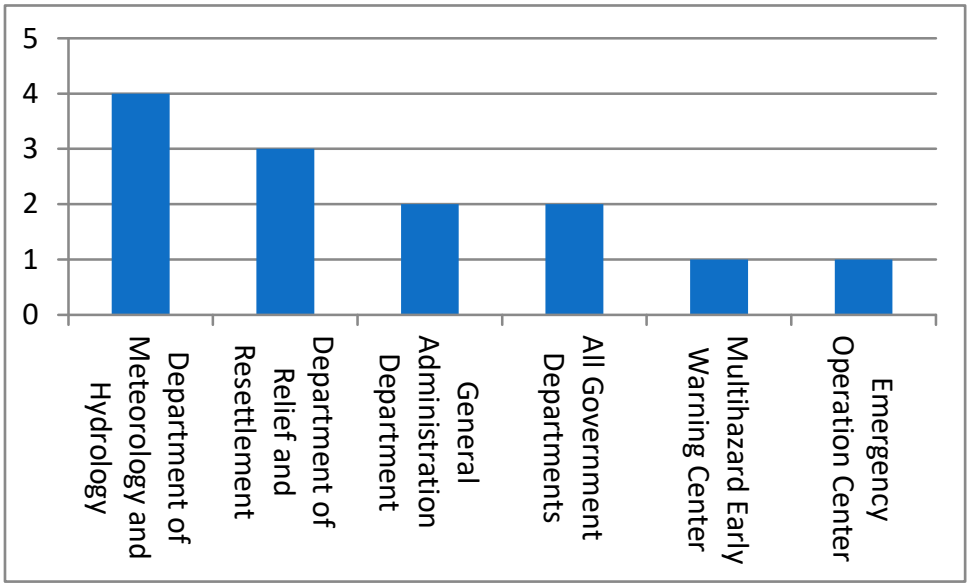

Figure (4) Department responsible for MHEW education and hazard awareness
Source: Authors' field survey (2017).

13.1.3 Role of the HEI: Interview and Focus group findings

Concerning the role of HEIs in improving MHEW for coastal resilience, all interviewees answer the question. Of them, 11 respondents mentioned that it should be included in the university curriculum and adopted a new disaster related course in university so that university could share knowledge to the public. Two respondents answer that HEIs should be a place for training and technician incubator for disaster management. Public lectures are also effective in giving awareness to the public. One interviewee pointed that HEIs could provide existing Disaster Management Training Center at Hinthada by means of technology and human resources to be effectively training the students who come from all government staff.

Ten out of 14 interviewees agree that university should support for the improvement of MHEW and coastal community resilience by mean of conducting many researches. This is because universities have many facilities and human resource to do research. They further suggested that student should be assigned to do MHEW and community resilience related research in their term paper, master and PhD dissertations. Then, the results should be published to widely inform the public. One respondent also urged that university should be the place for measuring, analyzing and forecasting of disaster by means of research. One respondent suggests that all university students should have disaster knowledge before they graduate. Thus, they can help themselves and their community when disasters have happen. In addition, they can give public awareness talk in rural areas as a campaign during the summer holiday.

Generally, university plays an important role for giving awareness to the public, nurturing scientist and conducting MHEW related research. Although all above mentions things are clearly mentioned in the existing law and regulations, implementation is still very weak at the university level.

13.1.4 Barriers faced by HEIs: Interview and Focus group findings

All 14 interviewees answered the question related to barriers and challenges in improving MHEW system and coastal community resilience. Seven out of 14 interviewees mentioned the lack of funding as a major barrier while inter-ministerial cooperation and lack of human resources are also distinguished barriers (Figure 5). Two respondents answered that government support is also important for the improvement of MHEW.

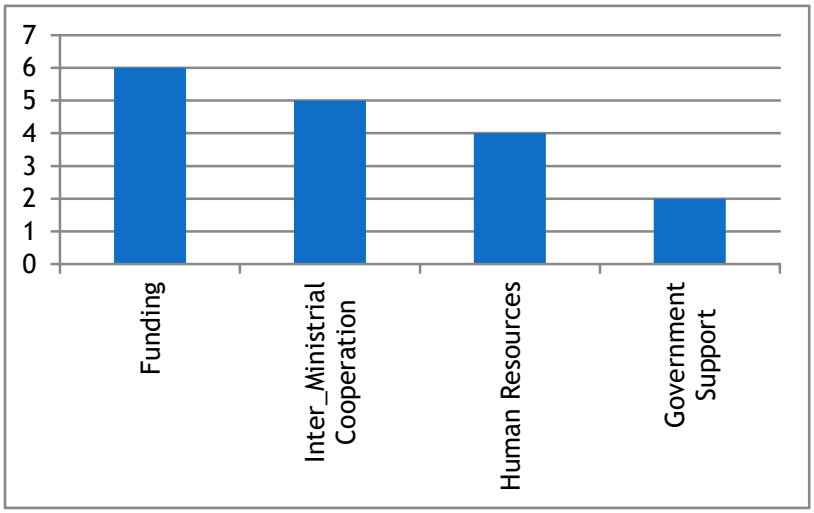

Figure (5) Barriers/ challenges of HEI in their efforts for improvement of MHEW and coastal community resilience (Multiple answers)
Source: Authors' field survey (2017).

As a means of overcoming the above mentioned barrier interviewees suggest that cooperation is necessary among the related ministries. Involvement of university in this process is not too high and other related ministries need to push the Ministry of Education for more cooperation. One respondent mention that

"Concerning funding, the role of government is very important. The UN and NGO are ready to offer grants but the government should coordinate for it. If the government deals with it as a national policy, fund can also come from other donors" (MyIL11).

All departments should assign a section related to a specific topic (MHEW, coastal community resilience, etc.) and should keep resource persons for that particular case. Otherwise, different participants attend a series of meeting and linkages will be lost among

the participants and could not effectively discuss and implement the programme. It is also needed to connect with international higher education institutions to get technology and funding. Sometimes, it is important to get data from government offices and to collect the real ground data without the permission from central government level. Therefore, it is also important to get participation of both higher and local authorities.

Interviewees are asked to mention the possible ways that could effectively support capacity building of the community and MHEW. Their results are summarized in following figure (6). Majority of respondents pointed out that University can help capacity building by means of putting MHEW and community resilience in the university curriculum both as minor and major subjects. In addition, there should have special training course of training for trainers in university. The student who trained from this course will go to their communities and give public awareness in summer vacation with the sponsorship of the government. Such kind of training and public awareness programme will very effective and benefit for local community and students will receive confidence and satisfaction for contribution of knowledge to the community.

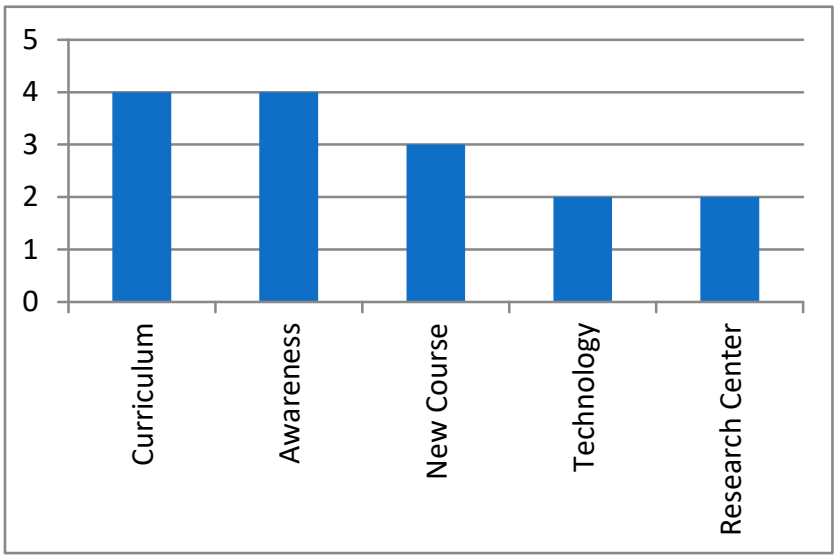

Figure (6) Possible supports from Higher Education Institutions for capacity building (Multiple answers)
Source: Authors' field survey (2017).

As a further contribution of university to the MHEW and coastal community hazard awareness, some respondents urged that university should open new courses related to MHEW and capacity building of local community. Two interviewees believe that university is the source of knowledge and technologically could support for the MHEW, especially with mobile technology. Two respondents urged university to become a center that collects, analyzes and forecasts the multi hazard. It is because universities have many facilities and many students to collect data and as a part of their academic path students could conduct their term paper and dissertation on this topic.

Generally, lack of funding, poor inter-ministerial cooperation, and lack of human resources are the main challenges of the university in contributing to the MHEW and coastal

community resilience. Cooperation among related ministries and networking with more advanced universities for technology and funding are important ways to overcome such barriers. Universities could contribute to their communities by means of giving awareness, nurturing scientist and experts, innovating MHEW, and enhancing capacity building of coastal community by using its existing infrastructure and knowledge and technology.

14. Conclusions and Recommendations

Conclusions

This report is part of the CABARET project and intends to find out the current situation of MHEW in coastal resilience by using available existing literature and stakeholder interviews conducted during July and August 2017.

Myanmar coastal area is exposed to disaster such as cyclone, storm surge, flood and Tsunami. Since Indian Ocean Tsunami (2004) and Cyclone Nargis (2008), people become well aware of natural disaster and pay attention on MHEW. Apart from cyclone and Tsunami, riverine flood is also a frequently occurs hazard in Ayeyarwady Delta. Damages occur from coastal hazard in Myanmar impacts on social and economic environments of both coastal communities and the whole country.

In Myanmar MHEW system, the Department of Meteorology and Hydrology (DMH) is mainly responsible for providing the early warning system to higher authorities, local government, disaster risk reduction agencies, media, international NGOs, Myanmar NGOs, and public. Although information of DMH go to all channels, distribution of early warning information is mainly made by General Administration Department which is an government organization that has their offices from national level to village level. Although there are some weaknesses, MHEW system is greatly improved in Myanmar during last 10 years.

Hazard assessment is very important information for improvement of coastal community resilience of Myanmar. However, it is only in the early stage of development and majority of hazard assessment work are focused on single hazard rather than multi hazard. Area specific multi-hazard assessments at township level are found in Rakhine State of Myanmar.

Myanmar has been actively considered and followed the guideline and agreements lay down by the Sendai Framework, Paris Climate Change Agreement and Sustainable Development Goals as post-2015 global frameworks in establishment of the MEHW. Especially, Myanmar Action Plan for Disaster Risk Reduction announced in 2012 and 2017 and Myanmar National Framework for Community Disaster Resilience announced in 2017 are all related to above global initiative for MHEW in coastal community resilience.

Although there are many improvements in MHEW of Myanmar during last decades, it is still need to improve MHEW. It is necessary to upgrade of existing MHEW Centres, need to widely use End-to-End Early Warning System, need to improved metrological observation and forecasting, enhanced flood monitoring and forecasting capacities.

Government lay down the police and enacted laws and orders in accordance with global initiative frameworks for coastal community resilience. However, its implementation is weak and effectiveness is difference based on the region and previous experience of disaster. Although awareness level of MHEW is very high in Ayeyarwady Delta while some other coastal area are still lack of awareness.

Based on experience derived from severe disasters during last 2 decades, government, NGO and civil social organization make large amount of effort to sufficiently support hard resilience mechanism such as road, cyclone shelter, etc. There are some software resilience mechanisms such as training and awareness programmes in some areas. However, other resilience mechanisms such as insurance system, creation of job opportunities for local community resilience have not yet well developed in Myanmar.

A lot of collaborations have been made between various ministry of Myanmar and regional partners such as UN agencies, international non-government organization, donors and regional and technical institutions for development of early warning and capacity building of community resilience. However, there are still need to improve in the area of infrastructure, technology and human resources development.

To improving the current MHEW it is necessary to collect reliable information of disaster and strengthening the communication channels between the Department of Meteorology and Hydrology, related ministries, and the General Administration Department. Communication channels from the General Administration Department down to the state, region, township, village tract, and village levels could be strengthened. It also includes use of mobile phones and social media for dissemination of information. In that case, cooperation among stakeholders, use of advance communication media and rising of public awareness are important enabler of MHEW development.

The policies and plans for the disaster management and public awareness programme have been laid down just after the Cyclone Nargis and reinforced during the last 10 years. In addition, implementation plans are belong to various ministries and cover from state level to village level. Development of MHEW and coastal community resilience is also part of these efforts.

University will plays an important role for giving awareness to the public, nurturing scientist and conducting of MHEW related research. Although the roles and responsibilities of universities are clearly mentioned in the existing law and regulations, actual implementation is still very weak in practice.

Lack of funding, poor inter-ministerial cooperation, and lack of human resources are the main challenges of the university in contributing to the MHEW and coastal community resilience.

Recommendations

To establish effective MHEW system and contribute to the coastal community resilience

1) it is necessary to upgrade hazard forecasting equipment and technology,
2) need to upgrade hazard information dissemination channels by using modern technology,
3) need to widely give awareness to the public,

4) need to reinforce existing infrastructures of coastal area and
5) need to establish insurance system and post disaster recovering funding.

Since Myanmar is implementing MAPDRR (2017) in line with global initiatives, it is relatively easy to get both funding and technical assistance from cooperating regional and international partners and donors. It is important to successfully implement this DRR plan since it is related to the economic development policy of Myanmar. All stakeholders involve in the process must be closely cooperate to get success.

University can help capacity building by means of putting MHEW and community resilience in the university curriculum as a major or minor subject. In addition, there should have special training course of training for trainer in university. The student who trained from this course will go to their communities and give public awareness in summer vacation with the sponsor of government. Such kind of training and public awareness programme will very effective and benefit for local community and student will receive confident and satisfaction for contribution of knowledge to the community.

Universities could contribute their communities by means of giving awareness, nurturing scientist and experts, innovating MHEW, and enhancing capacity building of coastal community by using its existing infrastructure and knowledge and technology. Cooperation among related ministries and networking with more advanced universities for technology and funding are important ways to overcome some barriers of capacity building and promotion of MHEW and resilience research.

List of References

1. AHA Centre (2015) *Country report, Myanmar: national disaster risk assessment and area business continuity plan formulation for industrial agglomerated areas in the ASEAN Region.* Mitsubishi Research Constitute, Inc. Available from http://open_jicareport. jica.go.jp/pdf/1000023395.pdf [Accessed: 2/3/2018]
2. Asian Disaster Preparedness Center (ADPC) (2009a) *Institutional arrangement for disaster management in Myanmar*, ADPC, Yangon.161p. Available from http://reliefweb.int/sites/reliefweb.int/files/resources/Ref_Doc_Institutional_Arrangements_for_DRR_ADPC_2009.pdf [Accessed: 2/12/ 2017]
3. Association of Southeast Asian Nations (ASEAN) (2005) *ASEAN agreement on disaster management and emergency response*, Vientiane, 26 July. Available from http://www.aseansec.org/17579.htm [Accessed: 2/3/2018]
4. Association of Southeast Asian Nations (ASEAN) (2009) *Regional disaster management agreement enters into force*, ASEAN Secretariat, 24 December. Available from http://www.aseansec.org/24136.htm [Accessed: 2/3/2018]
5. Center for Excellence in Disaster Management and Humanitarian Assistance (CE-DMHA) (2017) *Myanmar (Burma) disaster management reference handbook*, Hawaii: CE-DMHA.
6. Delta Alliance (2015) *Vulnerability and resilience assessment of the Ayeyarwady Delta, Myanmar.* Available from http://www.delta-alliance.org/media/default.aspx/emma/org/10862457/DA+No10+Vulnerability+and+Resilience+Assessment+of+the+Ayeyarwady+Delta+in+Myanmar.+Full+assessment+phase.pdf [Accessed: 2/3/2018]
7. Department of Population (DoP) (2016) *The 2014 Myanmar population and housing census, the union report: religion census report volume 2-C*. Nay Pyi Taw: DoP (Ministry of Labour, Immigration and Population).
8. Don, T. (2015) *Youth volunteers leading disaster response in Myanmar: Impact story: Yangon*: ADPC. Available from http://www.adpc.net/igo/category/ID1110/doc/2016-s84Aq1-ADPC-Web_-_Impact_Stories_-_Myanmar_FInal_-_Single.pdf [Accessed: 3/12/2017]
9. European Union (2015) *Myanmar/ Burma- Cyclone and floods*. Available from http://www.ananda-travel.com/images/ECDM_20150804_Myanmar_Floods.pdf [Accessed: 2/3/2018]
10. Government of the Republic of the Union of Myanmar (GoUM) (2013) *Natural disaster management law, (The Pyidaungsu Hluttaw Law No. 21/2013)*, GoUM, Nay Pyi Taw. Available from http://www.themimu.info/sites/themimu.info/files/documents/Natural_ Disaster_Management_Law_2013_ENG.pdf [Accessed: 2/12/2017]
11. Government of the Union of Myanmar (2015) *Myanmar: Post-disaster needs assessment of floods and landslides,* Myanmar. Available from http://earlyrecovery.global/ sites/default/files/myanmar000post0uly000september02015_1_0.pdf) [Accessed: 2/3/2018]
12. Horton, R., De Mel, M., Peters, D., Lesk, C., Bartlett, R., Helsingen, H., Bader, D., Capizzi, P., Martin, S. and Rosenzweig, C. (2017) *Assessing climate risk in Myanmar: summary for policymakers and planners*. New York, NY, USA: Center for Climate Systems Research at Columbia University, WWF-US and WWF-Myanmar, UN-Habitat Myanmar. Available from http://www.fukuoka.unhabitat.org/programmes/ccci/pdf/ASSESSING_CLIMATE_RISK_IN_MYANMAR_Summary.pdf [Accessed 2/3/2018]

13. International Federation of Red Cross Crescent Society (2017) *Myanmar: Tropical cyclone Mora, Bulletin No. 1*. Myanmar. Available from https://reliefweb.int/report/myanmar/myanmar-tropical-cyclone-mora-information-bulletin-no-1 [Accessed: 2/3/2018]
14. Krishnan, M, S. (1949) *Geology of India and Burma*, The Madras Law Journal Office, Madras.
15. Malteser International (2013) *Mapping of stakeholders and initiatives on early warning system in Myanmar*, Yangon, Malteser International. Available from https://www.preventionweb.net/files/42369_42369publicationmappingonewsmyanmar.pdf [Accessed: 2/3/2018]
16. Ministry of Social, Welfare, Relief and Resettlement (MSWRR) (2017) *Myanmar national framework for community disaster resilience*, Nay Pyi Taw, MSWRR. Available from https://www.preventionweb.net/files/submissions/52573_myanmarcommunityresiliencframework.pdf [Accessed: 2/3/2018]
17. National Disaster Management Committee, Republic of the Union of Myanmar (NDMC) (2017) *Myanmar action plan on disaster risk reduction 2017***,** Nay Pyi Taw: NDMC. Available from https://themimu.info/sites/themimu.info/files/documents/Core_Doc_Myanmar_Action_Plan_on_Disaster_Risk_Reduction_2017.PDF [Accessed: 2/3/2018]
18. National Disaster Preparedness Central Committee (NDPCC) (2009) *Standing order on natural disaster management (finalized in January 2009 and updated in 2011)*, Translated and printed by ADPC. Available from http://humanitarianlibrary.org/sites/ default/files/2014/02/standing_order_on_natural_disaster_management_myanmar.pdf [Accessed: 2/3/2018]
19. Pramumijoyo, Ir, S. (2010) *Report on regional geology of Myanmar*, Faculty of Engineering, Department of Geological engineering, Gadjah Mada University. Available from http://myanmar-preview.iwmi.org/sites/default/files/Documents/regional_ geology_of_myanmar.pdf [Accessed: 2/3/2018]
20. Relief and Resettlement Department (RRD) (2009) *Hazard profile of Myanmar*, Jointly prepared by DMH, FD, RRD, ID, FSD, MES, MGS, MIMU, ADPC, Yangon, RRD. Available from http://www.preventionweb.net/files/ 14567_14567HazardReport 25.8.091.pdf [Accessed: 2/3/2018]
21. Relief and Resettlement Department (RRD) (2012) *Myanmar action plan on disaster risk reduction,* Myanmar. Available from https://www.preventionweb.net/files/18657_ myanmaractionplanondisasterriskredu.pdf [Accessed: 2/3/2018]
22. Reza, M.E. (2009) *ASEAN's evolution in disaster management*, 26 October. Available from http://www.articlesbase.com/politicsarticles/aseansevolutionindisastermanagement1380093.html#ixzz0xnVp2XIl [Accessed: 2/3/2018]
23. United Nations Development Programme (UNDP) (2011a) *Multi-hazard risk assessment in Rakhine State of Myanmar: Final Report,* Yangon: UNDP. Available from http://www.adpc.net/igo/category/ID277/doc/2013-e38Lcp-ADPC-FINAL_Report.pdf [Accessed: 2/3/2018]
24. United Nations Development Programme (UNDP) (2011b) *Multi-hazard risk assessment in Rakhine State of Myanmar: additional technical details*, Yangon: UNDP. Available from http://themimu.info/sites/themimu.info/files/documents/

Assessment_MultiHazardRiskAssessmentinRakhine_TechDetails_UNDP_Nov11.pdf [Accessed: 2/3/2018]

25. UNHABITAT, (n.d, a) *A guide for village carpenters on how to build a safer shelter*, Yangon: UNHABITAT. Available from http://reliefweb.int/sites/reliefweb.int/files/resources/3EA7B74503F9A19B492575E600060277-UNhabitat_shelter%20carpenters_jun2009.pdf [Accessed: 2/3/2018]
26. UNHABITAT, (n.d, b) *Manual for cyclone: causes, effects and preparedness*, Yangon: UNHABITAT. Available from http://unhabitat.org.mm/publications/manual-on-cyclone-causes-effects-preparedness/ [Accessed: 2/3/2018]
27. UNHABITAT, (n.d, c) *Manual for fire: causes, effects and preparedness*, Yangon: UNHABITAT. Available from http://unhabitat.org.mm/publications/manual-on-fire-causes-effects-preparedness/ [Accessed: 2/3/2018]
28. UNHABITAT, (n.d, d) *Manual for flood: causes, effects and preparedness*, Yangon: UNHABITAT. Available from http://unhabitat.org.mm/publications/manual-on-flood-causes-effects-preparedness/ [Accessed: 2/3/2018]
29. UNHABITAT, (n.d, e) *Manual for earthquake: causes, effects and preparedness*, Yangon: UNHABITAT. Available from http://unhabitat.org.mm/publications/manual-on-earthquake-causes-effects-preparedness/ [Accessed: 2/3/2018]
30. UNHABITAT, (n.d, f) *Seismic hazard profile of Myanmar: state, region and selected cities (in Myanmar Language)*, Yangon: UNHABITAT. Available from http://unhabitat.org.mm/wp-content/uploads/2016/09/1-Seismic-Hazard-Profile-of-Myanmar_resized1.pdf [Accessed: 2/3/2018]
31. UNHABITA, (n.d, g) *Township disaster management plan (In Myanmar),* Yangon: UNHABITAT.
32. UNHABITAT, (2011) *Township disaster management plan: Bogalay,* Yangon: UNHABITAT.
33. UNICEF, (2015) *Risk assessment roadmap of Myanmar*, Myanmar. Available from https://www.adpc.net/igo/category/ID937/doc/2015-x1SFw3-ADPC-Myanmar_Risk_Assessment_Roadmap.pdf [Accessed: 2/3/2018]

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APPENDIX 1:

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

Name of the Document	Document Reference	Brief Description of the Document	Main initiatives/Actions highlighted in the Document	Key Informants (if given)
LITERATURE REVIEW FINDINGS				
Standing Order on Natural Disaster Management	Standing Order on Natural Disaster Management, Asian Disaster Preparedness Center (NDPCC), (2009)	It is a key document defining the mandate, roles and responsibilities for national level institutions in disaster management.	– guides the formation of committees and coordination mechanisms for a timely and coordinated disaster response – provides the role of the armed forces in expediting search and rescue activities, protection and other disaster relief efforts	
Myanmar Action Plan on Disaster Risk Reduction	Myanmar Action Plan on Disaster Risk Reduction, Relief and Resettlement Department (RRD), (2012)	It is a framework for multi-stakeholder engagements in Disaster Risk Reduction.	– identifies the need for strengthening the policy environment, – scales up implementation through local development, – promotes volunteerism, and – establishes financing mechanisms for community-level disaster risk reduction measures	

Name of the Document	Document Reference	Brief Description of the Document	Main initiatives/Actions highlighted in the Document	Key Informants (if given)
LITERATURE REVIEW FINDINGS				
Natural Disaster Management Law (Law No. 21/2013)	Natural Disaster Management Law, Government of the Republic of the Union of Myanmar (GoUM), (2013)	Its main purpose is to save lives and alleviate human suffering by connecting people, improving coordination and building capacity.	– provides the establishment of disaster management bodies and their duties; – calls for integrating disaster risk considerations in development processes; – establishes the government-led institutional setup at all levels of administration; – requires close coordination between government, civil society groups, other non-government organizations (NGOs), and international and regional organizations	
Myanmar National Framework for Community Disaster Resilience	Myanmar National Framework for Community Disaster Resilience, Ministry of Social, Welfare, Relief and Resettlement (MSWRR), (2017)	It main purpose is to achieve people-centered, inclusive, and sustainable socioeconomic development in the face of disasters triggered by natural hazards and climate change. The framework articulates a common understanding, proposes a coherent	– identifies potential opportunities for rural livelihoods and village infrastructure, urban development, environmental conservation and forestry, financial inclusion, social protection and disaster risk management – achieves community disaster resilience outcomes by strengthening community disaster resilience through rural livelihoods and village infrastructure, urban development and forestry – reaches out to the most vulnerable by strengthening community disaster resilience through financial inclusion and social protection	

		approach, and identifies potential opportunities for strengthening the resilience of communities.	– strengthens disaster preparedness and coordination – monitors and evaluates the implementation of the national framework	

Source: NDPCC (2009), RRD (2012), GoUM (2013) & MSWRR (2017)

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