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

INDONESIA

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1. Executive Summary

Indonesia is one of case study for national survey of CABARET (Capacity Building in Asia for Resilience Education), a regional research cooperation between Higher Education Institutes (HEIs) in Asia (region 6) and Europe, and among Asian HEIs themselves, that aims to build capacity for international, to develop/improve Multi Hazard Early Warning System (MHEWS) and to increase disaster resilience among coastal communities. This national report presents the result of survey which covered several matters related to current status of the process development of National Multi Hazard Early Warning System (National-MHEWS) in Indonesia and the baseline development of disaster resilience initiatives to save communities at risk. The challenges and positioning of National Multi Hazard Early Warning System in Indonesia for the wider trajectories of social change in societies and communities at risk are also presented in this report.

To achieve aim of CABARET research from Indonesian perspective and needs, The Institut Teknologi Bandung and Andalas University have conducted national and local survey using an integrated and holistic data acquisition (both for primary and secondary data approach). Literature review at national level taken were used as secondary data, i.e. detailed information of current status of National MHEWS process development and baseline of data disaster resilience initiatives at the coastal area of Indonesia including the key stakeholder of coastal hazard early warning system and coastal disaster resilience. The interview to key stakeholders at national level was conducted as primary data collection to validate the findings from literature study and get the opinions of the interviewee on several issue related to MHEWS, Coastal Resilience and role of HEI,s to improve MHEWS and coastal resilience. Total number of interviewee at national level is 12 person representing: Lines Ministries, National institutions and HEIs with average duration of interview approximately 1 hour for each person. Meanwhile, at the local level, there were 15 person that have been interviewed representing government officials, schools, NGOs, hotels, restaurants, communities and academia/HEI's. To provide findings and recommendations, the qualitative and quantitative analysis was used.

Several findings includes type of coastal hazards and its impact generated, actions/initiatives related to early warning system and current state for the development of National Multi Hazard Early Warning System, enhancement of coastal resilience, identified key stakeholder in MHEWS and coastal resilience, and the expected role of the HEIs in improving MHEWS and Coastal Resilience.

As an archipelago country, Indonesia are prone to many types of coastal hazards, such as tsunamis, earthquake, sea erosion and floods, landslide, windstorms and extreme weather. From these hazards, earthquake and tsunami have the most significant impacts on both number of death toll and the economic losses. For example, 2004 Indian Ocean Tsunami has caused USD 4451.6 Million damage and losses, 110,229 peoples reported dead, and 12,132 people missing, more than 703,518 were displaced. (BAPPENAS, 2005), beside it has caused severe damage and invaluable psychological impact that causing trauma effect toward human lives.





This 2004 event has become a wake up call for Indonesian Government followed by Indian Ocean Countries regarding the need and importance of the development of Tsunami Early Warning System in Indonesia. Ina TEWS (Indonesian Tsunami Early Warning System) which was developed since 2005 and established by November 2008. There are two component of the system, i.e. upstream and downstream, upstream has been developed based on technology while downstream will be very much relied on the local capacity of downstream warning chain to disseminate the warning information in the format of order for evacuation.

To complement with the warning system, effort on mitigating and reducing the impacts of coastal hazard are needed. Indonesia has done several initiatives for disaster risk assessment as initial steps in conducting disaster risk reduction efforts. Standing with the establishment of BNPB – National Disaster Management Agency on 2008. Then in 2012 were BNPB regulation on Disaster Risk Assessment Guideline are issued. In 2013 Disaster Risk Index issued by BNPB. This index is becoming reference for Bappenas in preparing National Mid Term Development Plan (RPJMN 2015-2019) on disaster management sector. By 2015, disaster risk assessments was improved by using 2015 data and produced 1: 250,000 scale of disaster risk map for the whole region of Indonesia. In 2016, BNPB published book of Indonesian Disaster Risk which was based on the results of the 2015 assessment. To support these initiatives, BNPB has also launched software applications to detect and response potential disaster i.e. Ina-Safe and Ina-Risk, Ina-Ware that were developed under collaboration with several international organization such as AIFDR, GFDRR, USAID, PDC etc.

Government of Indonesia has also developed several other early warning system for coastal hazard to follow Ina-TEWS (Indonesia-Tsunami Early Warning System), they were Ina-MEWS (Indonesia-Meteorological Early Warning System) and Ina-CEWS (Indonesia-Climate Early Warning System). BMKG is leading institutions and responsible in the upstream area for those early warning system. It was expected that these hazard/risk baseline early warning system can constitute one multi hazard early warning system.

All the initiatives related to early warning system for coastal resilience that conducted by Indonesia, are the efforts of Government of Indonesia for participating and implementing global initiatives commitment, such as SFDRR, SDGs and Paris Climate Change Agreement, are in line with national development goals i.e. to protect growth centers from natural disasters and climate change. Thus, Indonesia has also adopted those global initiatives into National Mid Term Development Plan.

To support the efforts of early warning system for coastal resilience, several related law, regulation, policy and guideline have been published. The umbrella of law for disaster management plan and implementation in Indonesia is law no.24/2007 on disaster management. Early warning is part of disaster management in the phase of situation with potential disaster. Another Law is Law 31 of 2009 on Meteorology, Climatology and Geophysical which become basis for role, task and responsibility of BMKG as a leading institutions in upstream area of early warning system. BMKG has also developed and issued The National Guideline on Tsunami Warning Services in 2012 updated in 2016. The guideline provides official information regarding the Indonesian Tsunami Early Warning System (InaTEWS). In the downstream component, several guidelines for disaster resilience program are published by BNPB such as DESTANA-Desa Tangguh Bencana (Disaster Resilience Village),





Disaster Safe School, and Communities Participation in Disaster Management etc that could be used as a mechanism to improve the community capacity in responding tsunami warning.

The actions/initiatives including norm, standard, policies, regulation and current efforts from Indonesia are still needed to be continued and sustained for strengthening disaster awareness and preparedness including to improve hazard/risk base early warning system for coastal resilience. There are success and un-success stories to become lesson learned for implementing DRR initiatives in the future. The evaluation of DRR implementation in Indonesia need to be conducted in order to give input in developing National Multi Hazard Early Warning System policy, initiated by BNPB and other line ministries/institutions. Currently, the Presidential Decree on National Multi Hazard Early Warning System has been drafted and will be processed to establish the system.

Furthermore, to continue and sustain DRR initiatives in Indonesia, it is also needed a regional cooperation and role of HEI in improving MHEWS for Coastal Resilience. Regional cooperation has been done during this time, need to be further followed up and enhanced in various sector of disaster management including in preparation and development of National Multi Hazard Early Warning System. ICG/IOTWMS, WMO, AHA Center ACDM are among Indonesia government commitment at regional level in developing and implementing DRR initiatives in Indonesia.

HEIs plays important roles in DRR initiatives planning and implementation to improve MHEWS for Coastal Resilience. As mandated in Law No. 12 Year 2012, HEIs have been mandated with Three Responsibilities (Tridharma) i.e. education, research and community service. These mandate could be used as mechanism of HEI contribution for developing and improving effective MHEWS for Coastal Resilience, for example in the form of conducting evidence-based MHEWS related research, MHEWS education, increasing and awareness programmes for coastal resilience within the region and strengthening expertise/advocacy in MHEWS.

Contributions and participation of HEI and other stakeholders in the efforts of early warning systems could be carried out through several enablers factors associated with MHEWS for coastal resilience, such as Information and awareness promotion; preparation of community actions; monitoring and evaluation of natural disasters; partnership building with stakeholders; establishing mechanisms to link communities with policy makers etc.





2. Introduction

CABARET (Capacity Building in Asia for Resilience Education) 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 develop/improve Multi Hazard Early Warning (MHEWS) 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.

Indonesia is one of case study location for national survey of CABARET. This national report will discuss current status of the process development of National Multi Hazard Early Warning System (National-MHEWS) and the baseline of disaster resilience initiatives to save communities at risk. This will also discuss the challenges and positioning National Multi Hazard Early Warning System in Indonesia for the wider trajectories of social change in societies and communities at risk. For that purpose, Institut Teknologi Bandung and Andalas University have conducted integrated and holistic data acquisition (both for primary and secondary data), analyzed and provided the findings and recommendations. Literature review at national taken by the team to collect information and detail of current status process development of National MHEWS and baseline of disaster resilience at the coastal area of Indonesia. This step then was followed by main stakeholder interview to get details of following information:

- List of actions/initiatives, including, but not restricted to, policies, guidelines, national/local action plans, for National-MHEWS development at national level
- List of actions/initiatives including, but not restricted to, policies, guidelines, national/local action plans, for enhancing coastal resilience at national level
- Key stakeholders in MHEWS and coastal resilience at national/local level in Indonesia
- Current enablers in MHEWS and coastal resilience at national/local level in Indonesia
- Challenges associated with MHEWS and coastal resilience at national/local level in Indonesia
- Role of the HEIs in the Country in improving MHEWS and Coastal Resilience.





3. Methodology

To achieve the goal and objective of CABARET research from Indonesia perspective and needs, the figure below describe pathway of research methodology which will be explained in detail at the following paragraph.



FIGURE 1. METHODOLOGY OF RESEARCH

 Literature Review: conducted in depth study on several documents i.e. policies, guidelines, national/local action plans in Indonesia which covered several issues on coastal hazards, early warning system for coastal hazard, coastal disaster resilience, regional cooperation in disaster matter, current implementation global initiatives in Indonesia and role of Higher Education Institution's (HEI's) in disaster management including obstacle and challenges faced by HEI's.

Result and findings from literature study was classified into three main information i.e., (1) Actions/initiatives in Indonesia related to coastal hazard early warning system and coastal disaster resilience which covered name of actions, process of implementation, and outcome; (2) Key stakeholder in coastal hazard early warning system and coastal disaster resilience and (3) Summary of information related to coastal hazard, early warning system and coastal disaster resilience in Indonesia, regional cooperation in disaster issue and role of HEI's in national disaster management.

- Primary Data Collection and Analysis
 - Primary Data Collection

Further information of key stakeholder identified from literature study was obtained from interview based survey for primary data collection. List of key interviewee can be seen in Table 1 below. The survey was conducted at national level led by ITB and at local level, i.e. Padang City and West Sumatra Province, led by Andalas University.





Survey at national level covered upstream and interface part of early warning system, meanwhile local survey in Padang City represented interface and downstream mechanism of early warning system. Total number of interviewee at national level is 12 person representing: Lines Ministries, National institutions and HEIs with average duration of interview approximately 1 hour for each person. Meanwhile, at the local level, there were 17 person that have been interviewed representing government officials, schools, NGOs, hotels, restaurants, communities and academia/HEI's.





NO	PARTICIPANT CODE	NAME OF INSTITUTIONS & POSITION OF INTERVIEWEE	DESCRIPTION OF INSTITUTIONS
1	(I.I.G.01)	BMKG (Head of Service Center for Applied Climate Information - Drs. Maman Sudarisman, DEA)	 BMKG - Indonesian Agency for Meteorology, Climatology and Geophysics. BMKG has function to detecting and monitoring weather, climate and earthquakes data from more than 200 observation station in Indonesia. BMKG provide weather, climate, earthquake and tsunami information services to Indonesian government ministries, institutions, businesses and public. Currently BMKG has established hazard/risk based early warning system, i.e. Ina-TEWS, Ina-CEWS and Ina-MEWS with constitute as MHEWS.
2	(I.I.G.02)	BMKG (Head of Prediction and Weather Early Warning System Division - Ramlan, S.Si, M.Si)	SAA





NO	PARTICIPANT CODE	NAME OF INSTITUTIONS & POSITION OF INTERVIEWEE	DESCRIPTION OF INSTITUTIONS	
3	(I.I.G.03)	BMKG (Head of National Earthquake and Tsunami Center - Drs. Mochammad Riyadi, M.Si)	SAA	
4	(I.I.G.04)	BNPB (Director of Disaster Preparedness – Ir. Medi Herlianto, CES., MM)	 National Disaster Management Agency (BNPB) is an Indonesian leading government institution in coordinating the planning and implementation of disaster management activities in an integrated and emergency Implement disaster management and emergency (disaster prevention, preparedness, emergency response, and recovery) 	
5	(I.I.G.05)	PVMBG (Head of Landslide Mitigation Sub Division - Dr. Sumaryono, ST., M.Eng)	 Center for Volcanology and Geological Hazard Mitigation (PVMBG), Landslide Mitigation Sub Division has several duty and function i.e. mapping and technical recommendation for landslide mitigation, conducting research, investigation, and implementation of monitoring and early warning for landslide hazard, hazard modeling and dissemination information for landslide hazard and its mitigation 	
6	(I.I.G.06)	KEMENKO PMK / Coordinating Ministry of Human Development and Cultural Affairs (Deputy Assistant of Disaster Risk Reduction – Herbin Manihuruk, SE., M.Kes)	 Role of PMK is o conduct coordination, synchronization, formulation, determination, implementation of policies related to disaster risk reduction. Also conduct monitoring, analysis, evaluation reporting activities in the field of mitigation and capacity building of the community 	
7	(I.I.G.07)	Sub-Directorate of Under Developed and Disaster Prone Regions BAPPENAS (Senior Researcher in Disaster Field – Hermani Wahab)	 National Planning Agency (BAPPENAS) Sub-Directorate of Under Developed and Disaster Prone Regions have the duty to carry out the prepare materials for coordination, formulate and implement policy, monitoring, evaluation, and control of national development planning in under developed and disaster prone Regions. 	
8	(I.I.G.08)	Research Center for Geo- Technology LIPI (Senior Researcher in disaster field – Dr. Herryal Anwar)	 Research Center for Geotechnology (LIPI) conducting research in the field of geo-technology to address the various problems and challenges in increased geological and climate disaster risks, land and water degradation, limited energy etc 	
9	(I.I.G.09)	ATR (Head of New Area Arrangement - Budi Santosa/Yohanes Fajar Setyo Wibowo)	 Ministry of Agrarian and Spatial Planning has responsibilities regarding to the spatial plan. Main responsibility of ATR in disaster field is mainstreaming and integrating DRR into the spatial planning 	
10	(I.I.G.10)	BPPT (Senior Researcher in Center for Disaster Risk Reduction Technology – Ir. Iyan Turyana, MT)	 Center for Disaster Risk Reduction Technology is one of center in Indonesian agency for Assessment and Application Technology (BPPT) that has task to conduct assessment and application of disaster risk reduction technology. Tsunami Bouy is one of technology developed by this center. 	
11	(I.I.A.11)	LPPM ITB (Faculty Member, Executive Secretary for Continuing Education of Institute for Research and Community	 Institute for Research and Community Service (LPPM) has a roles to facilitate the implementation of the ITB tasks for the Three Responsibilities of HEI (Tridharma) that include education, research, and community service in a balanced 	





NO	PARTICIPANT CODE	NAME OF INSTITUTIONS & POSITION OF INTERVIEWEE	DESCRIPTION OF INSTITUTIONS
		Service, Vice Chair of Research Center for Disaster Mitigation – Dr. Irwan Meilano)	way. There are 7 center of LPPM ITB, the one related to MHEWS and disaster resilience are Atmosphere Center are RCDM.
12	(I.I.A.12)	Atmospheric Science Research Group - ITB (Faculty Member - Dr.rer.nat. Armi Susandi, M.T./Mamad Tamamadin, S.Si, M.Si	 Atmospheric Science Research Group has several studies related meteorological disaster such as weather and climate dynamics, the impact of weather and climate variability on the socio-economic life of the community, including the adaptation and mitigation of meteorological disaster

NO	PARTICIPANT CODE	DESCRIPTION OF INTERVIEWEE	
1	(I.I.G.13)	Head of BPBD of Padang City (Local Disaster Management Office – Mr. Edi Hasymi) and Head of BPBD of Pariaman City -Mr. Yaminu Rizal	BPBD is local disaster management organization which responsible in coordinating the planning and implementation of disaster management activities in every step of disaster management at local level
2	(I.I.G.14)	BPBD of Pesisir Selatan Regency (Local Disaster Management Office – Mr. Hasibuan)	SAA
3	(I.I.G.15)	Lengayang Sub District-Padang City (Mr. Asrul)	Local government at sub district level in Padang City
4	(I.I.A.16)	Disaster Research Center – Andalas University (Researcher - Abdul Hakam and Taufika Ophiyandri)	• Disaster Research Center of Andalas University (Pusat Studi Bencana (PSB) Universitas Andalas) is one of the research/study centers in Andalas University that was established to fulfil the need of community in West Sumatra in dealing with disaster. The establishment of the center was initiated by Lecturers in Engineering Faculty; especially from Civil Engineering Department.
5	(I.I.N.17)	Chair of KOGAMI (NGO) – Mr. Tomi Susanto	 KOMUNITAS SIAGA TSUNAMI is an organization which has been found by the local people in Padang City soon after they realized that their city was threatened by Tsunami hazard.
6	(I.I.N.18)	Chair of Jamari Sakato (NGO) – Mr. Khairul Fani	 A group of people involved in humanitarian activities known as the "Perform" program in West Sumatra, took the initiative to develop a larger network to better reach the vulnerable community's joints by building a social movement
7	(I.I.O.19)	Principal of SDN 27 Olo Padang -Mrs. Yumlisma	 SDN 27 Olo Padang is one of Elementary School in Padang City
8	(1.1.0.20)	Teacher of SDN 14 Olo Padang – Mrs. Rosnita	 SDN 14 Olo Padang is one of Elementary School in Padang City







NO	PARTICIPANT CODE	DESCRIPTION OF INTERVIEWEE		
9	(I.I.P.21)	Human Resource Manager, Hotel Mercure – Mr. Didi Putra	•	Hotel Mercure is one of Hotel in Padang City
10	(I.I.P.22)	General Manager Hotel Sofyan Inn Rangkayo Basa – Mr. Widadi Handoyo	•	Hotel Sofyan Inn Rangkayo Basa is one of Hotel in Padang City
11	(I.I.P.23)	HRD Manager Pangeran Hotel – Mrs. Desy Selviany	•	Pangeran Hotel is one of Hotel in Padang City
12	(I.I.P.24)	Supervisor Hau's Tea Restaurant – Ms. Ria	•	Hau's Tea Restaurant is one of Restaurant in Padang City
13	(I.I.P.25)	Manager Operasional Kafe Karambia – Ms. Wike Vivi Larenche	•	Kafe Karambia is one of Restaurant in Padang City
14	(I.I.O.26)	Public community – Ms. Halimar	•	Public community in Padang City
15	(1.1.0.27)	Public community – Mr. Iskandar	•	Public community in Padang City

• Primary Data Analysis

To simplify research analysis, comparison between regional and national questionnaire was done. Each question in regional survey monkey mapped into national questionnaire. Then, transcript data entered into excel format for tabulation in the form of graphic for quantitative analysis. Several additional data/information, were also entered for qualitative analysis based on main information obtained.

• Reporting : description of the national and local survey result including literature study and analysis.





4. Background

Indonesia is located on the geographic coordinates of 6.1750° S latitude and 106.8283° E longitude in southeastern of Asia. The total area of Indonesia is 1.913.578,68 square kilometers with extending of 5,120 kilometers from East to West and 1,760 kilometers from North to South and consist of 34 provinces, 17.504 islands and 12.827 coastal island.

Lying along the equator, Indonesia has a tropical climate, with two distinct monsoonal wet and dry seasons. Average annual rainfall in the lowlands varies from 1,780–3,175 millimeters (70-125 in), and up to 6,100 millimeters (240 in) in mountainous regions. Mountainous areas-particularly in the west coast of Sumatra, West Java, Kalimantan, Sulawesi, and Papua-receive the highest rainfall. Humidity is generally high, averaging about 80%. Temperatures vary little throughout the year; the average daily temperature range of Jakarta is 26-30 °C (79-86 °F).

The current population of Indonesia is 261,270,413 (UN estimation on 2016). Indonesia population is equivalent to 3.5% of the total world population. Indonesia ranks number 4 in the list of countries by population. The population density in Indonesia is 144 per Km2 (372 people per mi2). 53.4% of the population is urban (140,824,151 people in 2016). The median age in Indonesia is 28.6 years. 58% of the population live on the island of Java, the world's most populous island.

Due to Indonesia location on the Pacific Ring of Fire as shown in Figure 4 and at the meeting points of three tectonic plates: Indo-Australian, Eurasian and Pacific plates as shown in figure 3, making it one of the most volcano, earthquake, landslide, land subsidence and tsunami prone regions of the world. Besides the aforementioned geological hazards, Indonesia, being an equatorial tropical archipelago, annually witnesses several hydro-meteorological hazard such as rob, flood, flashflood, abrasion, sedimentation and meteorology hazards such cyclone (minor) and drought.







FIGURE 3. TECTONIC MAP OF INDONESIA AND SURROUNDINGS (SOURCE : BOCK ET ALL, 2003)



FIGURE 4. RING OF FIRE





5. Coastal Hazards

As also described in section 4, Indonesia is located in disaster prone area, which can be considered as the Laboratory of Disasters, due to its geographical, geological and demographic condition. As an archipelago country, coastal areas in Indonesia are prone to many types of coastal hazards, Setyawan (2008) stated that coastal hazard in Indonesia include tsunamis, high waves, coastal erosion, tidal floods and subsidence, river flood, and sedimentation. An average of 20-30 typhoons/tropical cyclones happened the country every year, with 5-7 of them considered the most destructive. Along with tropical cyclone events, there are collateral hazard such as landslides, floods, typhoon, drought, and extreme weather. According to 2005-2015 data from Indonesia Disaster Information Data (DIBI), most of the disaster in Indonesia are caused by hydrometeorology hazard (78%) and the rest is geological hazard (22%). The hydro-meteorological disaster occurring in Indonesia includes floods, extreme waves, land and forest fires, drought, and extreme weather. Geological disasters in Indonesia include earthquakes, tsunamis, volcanic eruptions, and landslides (RBI, 2016).



FIGURE 5. DISASTER OCCURRENCE IN INDONESIA 2002-2016 (SOURCE : BNPB, 2017)

The number of catastrophic events caused by geological factors is less significant than the number of disaster events caused by hydro-meteorological factors. Nevertheless, geological disasters like earthquakes and tsunamis, have a significant impact on both the victims and the economic losses. For example, Indian Ocean tsunamis 2004 has caused a USD 4451.6 Million damage and losses. In Aceh and North Sumatra Province in Indonesia, in example 110,229 peoples reported dead, 12,132 missing and 703,518 were displaced. (BAPPENAS, 2005).









FIGURE 6. TYPE OF COASTAL HAZARD IN INDONESIA

In interviews conducted, identified several hazard that can threaten coastal areas. Interviewee is allowed to mention more than one hazard that they think threatens Indonesia's coastal areas. According to the interview result presented in Figure 6, interviewee identified tsunamis as the most threatening hazard in coastal area. Another hazards that have a high potential in Indonesia coastal area such as earthquake, sea erosion, and floods. Other possible hazard are landslides, windstorms, and extreme weather.

5.1 Impact of the Coastal Hazards

5.1.1 Literature Review findings

Based on disaster data from BNPB (NDMO), the most deadly disaster in Indonesia is the tsunami. The number of victims and historical disaster events in Indonesia is presented in Figure 5.







FIGURE 7. RECENT MAJOR DISASTER EVENTS IN INDONESIA (SOURCE: BNPB, 2017)

Some of the impacts of earthquakes and its collateral hazard (such as tsunamis and landslides) are human fatalities, environmental damage, property loss and psychological impact. (IRBI, 2016) There're also impact to the economy system in the country. For example, in 2004 Indian Ocean tsunamis, national GDP growth reduced 0.1-0.4%. In Indonesia, the most affected sectors are housing and small and medium enterprises. (BAPPENAS, 2005). Graphic on victim and economic loss due to major disaster events in Indonesia illustrated in Figure 8.



FIGURE 8. DATA ON VICTIM AND ECONOMIC LOSS DUE TO DISASTER EVENTS IN INDONESIA (SOURCE: ANALYSIS BASED ON DIBI BNPB DATA)





5.1.2 Interview findings

According to the interview results, the main impact of the coastal hazard in Indonesia included damages to property, losses of lives, economic losses, safety aspect, building and infrastructure damage, environmental impact, agricultural impact, and psychological impact. Economic losses are caused by loss of livelihood that has an impact to income. That losses may occur in fisheries sector. Infrastructural and building damage can caused by lack of implemented building and infrastructure standard. Environmental damage caused by coastal hazard including erosion and abrasion in shoreline. In flooding or inundation, agricultural sector could impacted. Psychological impact can caused trauma that affected people. The coastal hazard impact graph according to the interview is presented in Figure 9.

The most perceived impacts of coastal hazard listed by interviewee are property damage and death. Death is associated to the settlement or workplace area near to the hazard source. Most of the people in coastal area work as fishermen and live near the beach, increasing their vulnerability.



FIGURE 9. IMPACT OF COASTAL HAZARD

"There will be direct and indirect impacts. The immediate impact will affect the environment, to everyone, to the community. There will be material loss. We often forget the indirect impact that will affect the poor. If there is shock that affect vulnerable people, it will be difficult to restore the situation." (I.I.G 07)

From I.I.G 07 statement, it can be seen that the long term indirect effect gives more impact than the direct effect. The impact is usually caused by loss of livelihood. The poor are the groups most affected by the indirect impacts.

"For the impact, it's not only to coastal communities alone but also threaten to the cities near the coastal area, such as Aceh, Padang, Banten, Pangandaran, Cilacap, and so on. High waves cause erosion, affecting the economy, infrastructure, threatening fishing communities, If in a





week they can not go to sea, their livelihood are also threatened. Disasters can cause poverty." (I.I.G 04)

In line with the statement from I.I.G 07, I.I.G 04 also mentions that the indirect impact that can occur due to the disaster is poverty. The impact will occur in the long run and threaten the sustainability of their livelihood.

5.2 Early Warning Systems available for Coastal Hazards

5.2.1 Literature Review findings

There are several early warning system installed in Indonesia that could detect and monitor potential coastal hazard. It is called INA-TEWS for tsunami, INA-MEWS for meteorological hazard, and INA-CEWS for climatological hazard. All of those hazard base early warning system are operated by BMKG.

Tsunami early warning system (INATEWS) starts from detection, monitoring, and analysis done by BMKG. Warning was then distributed to BNPB then continued the warning to the Emergency Operating Center (EOC) at local level. Then, the local authority of EOC is to activate the tsunami early warning system into order for evacuation. The tsunami early warning system in order for evacuation is shown in Figure 10.



FIGURE 10. INDONESIA TSUNAMI EARLY WARNING SYSTEM – INATEWS

There are several stages in the hydro-meteorological early warning system (INAMEWS) : monitoring, processing, and disseminating. Monitoring conducted by BMKG. The information is then processed to produce results about meteorological conditions. Dissemination in





INAMEWS is divided into local and national dissemination. The meteorological early warning system chain is shown in Figure 11.



FIGURE 11. INDONESIA METEOROLOGICAL EARLY WARNING SYSTEM – INAMEWS

In a climate early warning system (INACEWS) an early warning will be given when there are predictions of extreme conditions from climate modeling results. If there is no indication of extreme circumstances, climate information will be given as a basis for consideration in areas affected by climate such as agriculture and marine. The climate early warning system chain is shown in Figure 12.



FIGURE 12. INDONESIA CLIMATE EARLY WARNING SYSTEM – INACEWS

5.2.2 Interview findings

From the interview results, most of the interviewees know about INATEWS, but some of them didn't know about the other system. Interviewee from I.I.G 05 and I.I.G 08 also stated that





Indonesia have landslide early warning system, but because of its local impact, it only installed in several landslide prone area. There are two kind of Landslide early warning system according to interview with I.I.G 05. Type one is early warning system that give a warning based on the precipitation rate, and the second type give a warning based on the soil shear. The last version of land slide early warning system has become the standard (SNI) and processed into ISO. Early warning system availability level for coastal hazard is presented in Figure 13.



FIGURE 13. EARLY WARNING SYSTEM AVAILABILITY LEVEL FOR COASTAL HAZARD

Early warning system that has been operating in Indonesia is for Tsunami. According to I.I.G 02, Indonesia's early warning system of tsunami has been used at the international level. At Indian Ocean, Indonesia has become the center of earthquake and tsunami information. From the interviews obtained information that Indonesia has developed buoy for early detection of tsunami. Buoy is developed by BPPT. According to I.I.G 10, data from buoys has been integrated with data from BMKG.

From interview at the local level, the results shown that there is already installed sirens for early warning system. Most interviewee have known about the tsunami sirens installed in the area, but some of the sirens do not work when tested. It can be concluded that the availability of early warning system in Indonesia is good. But maintenance aspect should be considered to maintaining device performance.





6. Multi Hazard Assessments

Since 2010, Indonesia already has various methodologies for developing of disaster-prone maps that issued by several ministries / institutions, universities and donors. In 2012, the methodology agreed upon by all parties is become the Regulation of BNPB No. 2 in 2012. By involving various institutions, in 2013 Indonesia has a Disaster Risk Index issued by BNPB. This index is becoming reference for Bappenas in preparing the RPJMN 2015-2019 on disaster management. By 2015, disaster risk assessments improved using 2015 data and produced 1: 250,000 scale disaster risk map for the whole region of Indonesia. Then in 2016, BNPB publishes book of Indonesian Disaster Risk which is based on the results of the assessment in 2015. Indonesian Disaster Risk book contain estimated economic losses and death in multi risk hazard.

6.1.1 Literature Review Findings

Indonesia have conducted assessment for earthquake, tsunami, volcano, flood, landslide, drought, forest fire and land fire, extreme weather, extreme wave and abrasion, flash flood. Indonesia also has conducted multi hazard assessment at national level. Determination of multi-hazard risk index is conducted based on the merging analysis of the hazards index value for all types of hazards, vulnerability index values for all types of hazards, and capacity index values for all types of hazards. Multi-hazard risk calculation according to the Regulation of BNPB No. 2 2012 presented in Figure 14.



FIGURE 14. MULTI HAZARD RISK ASSESSMENT (SOURCE: REGULATION OF BNPB No.2/2012)

Output of the method in Regulation of BNPB No. 2 2012 is the level of disaster risk at the city / district level and the disaster risk map in national level.





6.1.2 Interview Findings

Mostly interviewee stated that Indonesia has conducted hazard based assessment. There are a lot of assessment that conducted by several institutions in Indonesia, but it was still national and macro level. There are also interviewee stated that currently BNPB has released Indonesian Disaster Risk Index and become a reference for National Development Plan (RPJMN 2015-2019) as a guide in the implementation of development. BNPB has also launched a portal of INA-Risk as disaster risk assessments and Disaster Risk Index in Indonesia that could be used for the planning in national, provincial levels and local. The assessment conducted for several hazard such as earthquake, tsunami, volcano, abrasion, coastal erosion, wind, and flood. The multi-hazard assessment conducted in Indonesia is at the regional, provincial or city levels. But most are still at the regional level. The parties involved in the assessment include BNPB (NDMO), international agencies, and universities.

Based on interviewee statement, the map produced by BNPB are still needed some improvement in risk calculation. Map available only for macro scale so that the results of the analysis cannot be used for planning on a local scale.

"For example, Ina Risk developed by BNPB, the resolution is still macro. The study conducted at micro level should have calculated the cross section of the river, high resolution of land use et cetera." (I.I.A 12)

"At national scale we have the capacity to do assessment. But detail assessment require detail map. Comparing with the requirement, Indonesia's capacity still not meet the requirement yet. There are only few institution that has a capacity to produce the map, such as Geological Agency, LIPI, and some universities. But it doesn't enough." (I.I.A 11)

Agree with I.I.A 12, I.I.A 11 stated that Indonesia still needs improvement in terms of providing basic data in the form of maps. I.I.G 09 as the government working on disaster-prone spatial layout also stated the importance of providing detailed maps for multi-hazard assessment on a local scale. The maps will be useful in planning evacuation route.

At the local level, interviewees from universities and BPBD (LDMO) to an assessment of single hazards. Assessment is used as the basis for preparation of disaster management plans. Interviewee from school and business is not aware about

Interviewee agrees that Indonesia has the capacity to conduct multi-hazard assessment. Indonesia learns and increases its capacity from historical disaster events. Other countries learn about earthquakes and volcanoes to Indonesia. In addition to being able to conduct multi-hazard assessments, the interviewee also believes that Indonesia has the ability to provide training and consultation in multi-hazard assessment.

"Yes. We often provide training. From the Pacific region there are 6 countries we invite for training." (I.I.G. 03)

Although it has the ability to conduct multi-hazard assessment and provide training and consultation to other countries, there are still human resource constraints. The number of





human resources that have capability in terms of multi-hazard assessment is still limited. Therefore, training is required to gain number of competent human resources in the multihazard assessment.

At the local level, local governments explain that they have the capability to conduct assessment. As explained by (I.I.L.13), there is access to the data for the assessment. They also trained for assessment.





7. Global Initiative

7.1.1 Literature Review findings

There are several global initiatives that considering early warning system development. The initiative is SFDRR, SDGs, and Paris Climate Change Agreement. One of the 7 priorities in SFDRR includes an element of increased public access to the Early Warning System to reduce vulnerability. (SFDRR, 2015) In SDGs, these initiatives are listed in targets 11.5, 13.1 and Target 13.3. Target 11.5 is significantly reduce the number of deaths and the number of people affected and substantially decrease the direct economic losses relative to GDP caused by disasters by 2030. This target can be reached by developing early warning system to prevent losses. Target 13.1 is strengthen the capacity of all countries, in particular developing countries, for early warning, risk reduction and management of national and global health risks. Target 13.3 is improved education, awareness raising and human and institutional capacity on climate change, mitigation, adaptation, impact reduction and early warning. (SDGs, 2015)

In Paris Climate Change Agreement, article 7 point 7C and Article 8 point 4A explained that one of the goals of cooperation within parties in climate change agreement is for strengthening scientific knowledge on climate, including research, systematic observation of the climate system and early warning systems, in a manner that informs climate services and supports decision-making. From both points it is seen that Paris Climate Change Agreement initiated cooperation in Early warning system for disaster caused by climate change. (Paris Climate Change Agreement, 2015)

At a national level, the global initiatives are adopted into several planning and policy documents. SFDRR and SDGs has been mainstreamed in RPJMN's (National Mid Term Development Plan) program that will be implemented by multi-sectoral agencies leaded by BNPB (NDMA). SFDRR and SDGs integration in the RPJMN program is illustrated in Figure 15.



Souce : BNPB, 2017

FIGURE 15. INTEGRATION OF SDGs AND SFDRR IN DEVELOPMENT PLAN





From figure 15, one of Indonesia's national development goals that stated in RPJMN is to protect growth centers from natural disasters and climate change. The national objectives are then made by incorporating target elements of SDGs and priorities of SFDRR. Target SDGs 11.5 that relate directly to priorities SFDRR 1, 2, and 3 are translated into 3 national goals. The national goals are presented in Table 2.

TABLE 3. INDONESIAN NATIONAL GOALS RELATED TO SDGS AND SFDRR

SDGs Global Target	SFDRR Priorities	National Goals
Target 11.5 : By 2030, significantly reduce the number of deaths and the number of people affected and substantially decrease the direct economic losses relative to GDP caused by disasters, including	Priorities 1. Reduce global disaster mortality by 2030, aiming to lower average per 100,000 global mortality between 2020-2030 compared to 2005- 2015	Reducing disaster risk index in high risk growth center.
water related disasters, with focus on protecting the poor and people in vulnerable situations.	Priorities 2. Reduce the number of affected people globally by 2030, aiming to lower the average global figure per 100,000 between 2020-2030 compared to 2005- 2015	Increased community and institutional capacity to build urban resilience to climate change and disaster.
	Priorities 3 . Reduce direct disaster economic loss in relation to global gross domestic product (GDP) by 2030	Availability of weather, climate, and disaster early warning system.

Source : RPJMN 2015 – 2019

The integration of the global and national agenda needs to be done from the planning stage to budgeting stage. SDGs can be easily integrated into the national development agenda. Moreover, in its inclusive approach, the involvement of the international community and the variety of technical activities of SDGs has the potential to bring much influence into the national agenda. These include new policy perspectives and approaches, technical tools, and civil society involvement, the private sector, including innovation. (UNDP, 2015)

BAPPENAS (National Planning Agency) has 2 deputy in charged for SDGs implementation in climate change adaptation and disaster risk reduction. The deputy are Deputy for Maritime and Deputy for Natural Resources. This deputy's institutional are stated in Kep.Pres (Presidential Decree) No. 59/2017.

Paris Climate Change Agreement has been mainstreamed in KLHK (Ministry of Environment and Forestry) program, even though Climate Change Council has been dissolved. At national level, Indonesia adopted Paris Climate Change Agreement to the Nationally Determined Contribution (NDC) in 2016. In NDC, stated that Indonesia is trying to increase social and livelihood resilience by developing climate early warning system.





7.1.2 Interview findings

At the national level, interviewees in the policy field know about the implementation of the global framework. I.I.G 06 and I.I.G. 07 are some of interviewee that worked in planning area. Those interviewee know about global initiative adoption into national document. However, knowledge about global initiatives in MHEWS from interviewees working in the technical field (I.I.G 08, I.I.G 10, I.I.G 11, and I.I.G 12) and local interviewee are limited.



FIGURE 16. GLOBAL INITIATIVES ON MHEWS

"Of the many global initiatives, these three initiatives are the main initiatives, so we referred to them, we already have President Decree 59 of 2017. The President Decree are created in 2014 before the SDGs are signed in 2014, Indonesia is given a draft of SDGs so we started to adjust RPJMN to the draft. So there are 3 RPJMN targets that are directly related. For example, in Perpres (Presidential Decree) there is a decrease in the number of fatalities. When translated into RPJMN, what data is needed?" I.I.G. 07.

As explained by I.I.G 07, global initiatives already adopted into national level policy. However, further step that still need to be developed are inter-organizational coordination in the process of providing and processing data. Along with I.I.G 07, I.I.G 06 state that global initiatives such as SDGs has been adopted into national planning policy.

"In SDGs Target 13.1: strengthen the resilience and adaptive capacity towards climate threats and natural disasters in all countries. In this Global agreements, Indonesian government agree to participate and play an active role in the preparation and implementation at the national development policy. This was stated in RPJMN 2015-2019 RKO and 2016, RKP 2017, and 2018. Development plans in both the disaster risk reduction and capacity building is a major concern. In 2015-2019 RPJMN directed to reduce the risk index in growth centers by





increasing the capacity of governments, local governments and citizens in the face of disaster. Thus, it can be said, global initiative has mainstreamed into planning in Indonesia." I.I.G 06.

"The Implementation has been already taken, but not in a massive and systemic yet. So, it should be packed in one system and has to be improved." (I.I.G. 04)

I.I.G 04 stated that implementation already taken by the government, but, along with I.I.G 07 statement, the implementation need system improvement. Also, coordination among stakeholder is needed to create a good and massive impact.

In local level, (I.I.L.13) stated that global initiatives have not been socialized to the regions. Only local university states that there is already a global initiative element in disaster risk reduction document. "In RPB (Disaster Management Plan), Sendai Framework, SDG, and Paris Agreement are used as guidance for making the guidelines." (I.I.A.16).

Interview result shows there is a difference in knowledge about global initiatives between local and national stakeholders.





8. Current National efforts towards MHEWS for Coastal Resilience

8.1.1 Literature Review findings

At national level, Badan Nasional Penanggulangan Bencana (NDMO) is hosting the Indonesian Disaster Data and Information (DIBI). DIBI has been adapted for local data and indicators, and has been used in risk mapping and risk indexing, used to create a disaster-prone area index (IRBI) and to support BNPB in making decisions on fund allocation, national programme policies and making plans to reduce the vulnerability of people living in highly-disaster prone areas. However, DIBI is sometimes affected by varying formats of data inputs, limited reliability of media sources, imprecise estimates available for disaster losses and inaccurate information leading to gaps in action and difficulty in obtaining reliable information from small districts. Indonesia is also benefiting from All-Hazard Warnings, Analysis, and Risk Evaluation (InAWARE), designed by the Pacific Disaster Centre (PDC), a web-based platform integrating information, modelling, and mapping technologies to provide disaster authorities with a stream of information on current hazards (BNPB, 2016).

Responsible organizations such as the Centre for Volcanology and Geological Hazard Mitigation (PVMBG) and Meteorological Cimatological and Geophysical Agency (BKMG), Indonesian Tsunami Early Warning System (InaTEWS) and Ministry of Public Work of Indonesia are working diligently to strengthen systematic collection, sharing and analysis of data on hazards, vulnerabilities and in disseminating this knowledge through training and education.

The InaTEWS is the only official tsunami EWS in Indonesia, and as such, all regions are required to adapt to this system. Pursuant to Law Number 31/2009 on Meteorology, Climatology, and Geophysics, only BMKG as the National Tsunami Warning Centre (NTWC) has the authority to issue a national tsunami early warning alert (BNPB, 2015).

Another early warning systems at national level are Indonesia Meteorological Early Warning System (INA-MEWS) which provides forecast information focused on meteorological hazard (includes heavy rainfall 1-hour up to 7 days ahead, flood, significant wave) and Indonesia Climate Early Warning System (INA-CEWS) which focused on atmospheric dynamics and climatic hazard. Current National efforts towards MHEW in Coastal Resilience (Herlianto, 2017) is describe in the following figure.







FIGURE 17. CURRENT EFFORT OF MULTI HAZARD EARLY WARNING SYSTEM. SOURCE: (HERLIANTO, 2017)

BNPB (NDMO) has a role as coordinator in the national system of multihazard early warning at the ministry or the institution level but it does not remove the authority of ministries or agencies to diseminate to the people (in this case, BMKG has the authority to issue a national early warning alert includes extreme events, earthquakes, and tsunami).

8.1.2 Interview findings

At national level according to (I.I.G.01), currently BMKG involves in several multihazard early warning system and already coordinated with local governments and some ministries by disseminating the issue of disaster by providing information (e.g coordinating to make flood potential maps and drought map by INA-CEWS). Another role of BMKG is "to provide and disseminate the information as soon as possible, how it can reach directly to the community" (I.I.G.02). Current efforts on MHEWS are working diligently (IIG03), but still need improvements including:

- Increasing cooperation;
- Improving the ability to monitoring;
- Disseminate;
- Increasing public awareness in order to improve the capacity of communities

Furthermore, (I.I.A.12) explains that the MHEWS has been built at 2016, but officially started at 2017. This effort is conducted under collaboration with NDMO (BNPB).

Currently there are existing early warning systems in ministries and agencies, but there is no standard mechanism and portals to provide early warning and easily understood by the public. Nowadays progress has implemented good coordination across relevant ministries and agencies and the technical coordination of the policies implemented PMK and BNPB. Currently there's a discussion of the preparation plan for multi hazard early warning: the





objective for the management of early warning in the national system of integrated and multihazard warning and evacuation that easy to understood by community (I.I.G.06).

Mostly, the interviewee stated that Indonesia has a national capability to assess multihazard threat information and advise to its coastal communities but "resources are limited while the impacts of disasters are vast" (I.I.G.06). In the engineering aspect, Indonesia has capability to assess of multihazard but there are non-technical aspect (I.I.G.10) and the complexity of hazard (I.I.A.11) that makes it seems to be heavy.

Mechanism, synchronization and connectivity are the key factor how the MHEW can reach into the last mile (I.I.G.02). The mechanism in order to reaching the last mile should be clear and straightforward with a simple method then the information can reaching to the smallest level of administrative (I.I.G.09).





9. Policies to improve MHEWS for Coastal Resilience

9.1.1 Literature Review findings

At national level, Indonesia has several policies related to disaster management that become basis in implementing disaster risk reduction efforts including improving early warning system and coastal resilience. In 2007, Government of Indonesia has issued disaster management law no.24/2007 as an umbrella for disaster management implementation in Indonesia. In this law, early warning is part of disaster management in the phase of situation with potential disaster. The early warning shall aim to take quick and appropriate disaster risk reduction actions and prepare emergency response actions. Early warning require observation of disaster signs; analysis of results from disaster signs observation; decision-making by the authorities; dissemination of disaster warning information; and community actions(Law 24,2017). Four Elements of People-centred Early Warning Systems (Risk knowledge, Monitoring and Warning System, Dissemination and Communication, Response Capability) has used in developing early warning system in Indonesia.

Currently, BMKG Indonesia has 3 main system on early warnings system i.e. Ina-TEWS (Indonesia Tsunami Early Warning System), Ina MEWS (Indonesian Meteorological Early Warning System) and Ina-CEWS (Indonesia Climate Early Warning System). One of the advanced and established system is Ina-TEWS which developed since 2008. To support Ina-TEWS, BMKG has developed and issued The National Guideline on Tsunami Warning Services in 2012. The guideline provides official information regarding the Indonesian Tsunami Early Warning System (InaTEWS), the warning chain from national to local levels, the sequence and content of warning messages - including recommendations on reaction to local authorities – as well as clarification on the roles, responsibilities and procedures of all relevant bodies (GFZ, 2017). BMKG as a leading institution in tsunami warning in Indonesia, has acknowledgement to become Tsunami Service Provider (TSPs) in Indian Ocean Tsunami Warning and Mitigation System. By using science and technological approach, in the upstream area, BMKG has succeed to play a role to release warning bulletins or warning cancellations during the earthquake and tsunami occurrence at national and regional level.

In the downstream/community level, the community preparedness in responding tsunami warning has been conducted by BNPB and other agencies using tsunami materials which provides practical concepts. Several related policies for improving disaster resilience at community level are provide in appendix 1 which among others are regulation on DESTANA-Desa Tangguh Bencana (Disaster Resilience Village), Disaster Safe School, Communities Participation in Disaster Management etc that could be used as a mechanism to improve the community capacity in responding tsunami warning. DESTANA is one of priority program in Mid-Term National Development Plan (RPJMN 2015-2019) and it has established 374 disaster resilience villages in 2016. DESTANA and other resilience programs still need to continue for strengthening disaster preparedness in Indonesia including to improve hazard/disaster early warning and coastal resilience.





Regarding to Multi Hazard early warning system policy, currently BNPB has been developing the draft of Presidential Decree on National Multi Hazard Early Warning System. The draft still on the process of cross-sectoral/institutional discussions. The decree will become umbrella for integrated MHEWS at national level. The development of presidential decree is based on the need for monitoring and early warning services of multi hazard, due to currently the early warning is only available for single hazard and it is not yet integrated into national multi-hazard early warning system that easily understood by the community. The content of presidential decree will consist of 6 chapter (General Provisions, Procedures for the Implementation, National Multi Hazard Early Warning System, Rights and Obligation of Community, Transitional Provisions and Closing Provisions). The content will also covered organization structure of National Multi Hazard Early Warning System, risk knowledge, monitoring and forecasting of disaster threat, analysis of disaster threat and risk, warning dissemination to the community and strengthening disaster preparedness of community (including rights and obligation). It is expected that the presidential decree will provide guidance on management of early warning system in one national system and multi hazard; and provide legitimation in giving guidance for evacuation which easily understood by community.

9.1.2 Interview findings



FIGURE 18. POLICY, LEGISLATION, GUIDELINES RELATED TO MHEWS

Most of interviewee mentioned that Indonesia has policies, legislation and guideline related to disaster management. Several interview (I.I.G.01), (I.I.G.02) and (I.I.G.03) stated that Law 31 of 2009 is related toward MHEWS because regulated all the aspect of meteorology, climatology and geophysics that impacts to multi-hazard. This law also become basis for BMKG in conducting their role, task and responsibilities. (I.I.G.03) mentioned that in the Law




31/2009, BMKG has the main task to observe, process and provide accurate and precise information related to meteorology, climatology and geophysics but BMKG it is not specifically assigned for multi-hazard. Other policies, legislation and guideline stated by interviewee are National Guideline for Ina-TEWS, Risk Assessment Guideline, Contingency Plan, RBI and Draft of Presidential Decree on National Multi Hazard Early Warning System. Based on (I.I.G.02) Ina-TEWS is example of success story from BMKG if seen from the indicator of tsunami earthquake potential, warning by sirens, installed signs and tsunami vertical evacuation shelters. The success implementation of Ina-TEWS was due to good collaboration and participation of all stakeholder. According to interviewee (I.I.G.03), current problem of Ina-TEWS is interface and downstream area which there are variation implementation mainly at local level. Thus, it is need a similar standard procedure in responding tsunami warning at local level. Beside, (I.I.G.10) stated that Indonesia need other guideline to support Ina-TEWS such as standardization of tsunami siren, specific frequency (channel) for disaster, etc.

Most of interviewee stated that the implementation of Risk Assessment Guideline and RBI are also still need evaluate because the guideline only provided for national level. It is need more detail assessment for application at local level. Nevertheless, (I.I.A.12) mentioned that Ina-Risk as part of BNPB policy in risk assessment reach 82% accuracy data for the flood hazard and 50-60% for landslide. For example, flash flood occurred in Bima has been validated used by combining Ina Risk and weather prediction, the result is quite appropriate to describe the condition of flash flood.

As refer to literature review, (I.I.G.06) also mentioned that Indonesia has been prepared Draft of Presidential Decree on National Multi Hazard Early Warning System and currently the draft is on the process of discussion among cross sectoral of ministry/institutional.

(I.I.G.09) mentioned that Ministry of Agrarian and Spatial Plan has developed Guideline for Resilience Assessment for the City in 2015. The guideline was provided for all disruptions in terms of spatial arrangement and has applied in 2016 in several cities i.e. Balikpapan, Bandung, Malang, Tangerang, Depok and Surabaya by disseminating forms to the local government. Due to constrain of the data, the application of the guideline unsuccessful.

At local Perspectives, several interviewee ((I.I.L.15), (I.I.N.17), (I.I.O.19), (I.I.P.21), (I.I.P.22), and (I.I.P.25)) stated that there were policies to improve MHEWS for coastal resilience but they could not mention the type of policies. The interviewee (I.I.L.13) also stated that there are available policies to improve MHEWS and Coastal Resilience, the implementation of the policies, there are some successful and some still need to be improved. Successful implementation such as many 'Kelompok Siaga Bencana' (*Disaster Community Groups*) that have been established in several area, Disaster education at school used to be conducted routinely. Meanwhile example of initiatives that have not been successful i.e., Tsunami drills has not been fully successful in several schools/community observed, because the participation of 'real community' was very limited; Tsunami buoys are vandalized; Tsunami sirens deployed by BNPB did not working/stolen/broken/no maintenance.





10. Resilience Mechanisms

10.1.1 Literature Review findings

(BNPB, 2015) states that since 2007, the Indonesian government has developed a robust legal framework to strengthen disaster risk management in the country by promulgating several laws, regulations, plans and policies. Besides national laws, regulations and decrees, Indonesia also conforms to the legally binding ASEAN Agreement on Disaster Management and Emergency Response (AADMER).

In line with the SFDRR commitments Indonesia recognizes the need to more comprehensively and sustainably develop its DRR commitments, building on past successes and learning from past failures and challenges. Engaging local authorities, improving disaster risk reduction governance at local level and ensuring that incentives are provided to ensure increases in relative allocations of local development budgets require sustained and coordinated attention from line ministries, and provincial and district leaders.

The national on-call budget and Special Allocation Fund or Dana Alokasi Khusus (DAK), is administered by BNPB as a contingency fund for disaster response but is accessible by many line ministries and local governments. Further work is required to better regulate the use of this fund, including clarifying the relationship between it and the need to ensure adequate financing at provincial and local levels, recognizing that there is an increasing tendency for calls to be made on the On Call budget for financing disaster-related programs which should rather be included in provincial and local budgets.

Indonesia implements social development programs for populations at risk including the rice for the poor program, the social security program for senior citizens and social assistance programs for people with disabilities. Disaster risk insurance, catastrophe bonds and other risk transfer mechanisms are under development in the country. The Ministry of Finance is working with insurance companies to experiment with different public and private insurance schemes.

Micro insurance and micro financing programs undertaken by the government and private sector have had limited penetration, and only in some areas, despite international reinsurance companies like Munich Re, Swiss Re and Zurich Insurance piloting different types of insurance schemes and projects in Indonesia (BNPB, 2016).

10.1.2 Interview findings

Currently, the government has undertaken the construction of coastal community resilience to disasters. Until 2015 the construction of an early warning system against tsunamis and place and evacuation has been implemented in the western region of Sumatra, South Java and Nusa Tenggara islands (I.I.G.07).





"Socialization, simulation and contingency plans are the examples of soft measure which has been adopted so far but to make the coastal more resilient, infrastructure investment in the long term need more attention" (I.I.G.05)

Similar with previous statement, (I.I.G.06) concluded that the investments related to disaster risk reduction will reduce the risks to the community. Structural mitigation as a hard measure to cope with disasters must consider the parameters and suitable investment form for particular prone area in Indonesia.

Mostly, the interviewee agreed that mechanisms having any links to national level development plans while (I.I.G.09) stated "there is link to national development but still normative. In the past, if the planning did not suit to the spatial plan, the program will become last priority. There is need a law enforcement in order to controlling spatial planning."





11. Regional Cooperation

11.1.1 Literature Review findings

Besides an ASEAN member, Indonesia also joined the South-West Pacific region. Within the region, Indonesia has developed a lot of cooperation in disaster with Australia and Pacific Islands. Regional cooperation has been manifested in Indonesia's participation in ICG / PTWS, ICG / IOTWS, SAO - FFGS, and AHA Center.

Indonesia is member of Regional V (South-West Pacific) in The Intergovernmental Coordination Group for the Pacific Tsunami Warning and Mitigation System (ICG / PTWS) together with Australia and Pacific Islands. ICG / PTWS has a goal of enhancing regional cooperation to achieve resilience, includes improving early warning system. Early warning system built in this region is designed to connect with other countries and integrated globally but still community focused and addresses all hazard. (ICG / PTWS, 2007)

Indonesia also involve in The Intergovernmental Coordination Group for the Indian Ocean Tsunami Warning and Mitigation System (ICG / IOTWMS). Indonesia become a Tsunami Service Provider along with Australia and India. ICG / IOTWMS works closely with regional, national and international organizations to maintain and expand the IOTWMS services and to ensure the intergovernmental cooperation works well. Since 2014, a particular focus of IOTWMS has been on community awareness and responsive mechanisms. Inside the ICG / IOTWMS there are three working groups and one team task. One of the working groups focuses on tsunami detection, warning, and dissemination. (ICG / IOTWMS, 2015)

The World Meteorological Organization sees the need for inter-regional cooperation in the weather forecasting system. The system is required for improving the timely delivery of flash flood information and other hydro-meteorological hazard. WMO initiated meeting for the establishment of a regional flash flood guidance system for Southeastern Asia-Oceania, hosted by BMKG Jakarta. Parties at the meeting agree to develop and implement flash flood guidance system. This system will significantly improve the capabilities of national meteorological and hydrological services system in Southeastern-Asia Oceania to produce timely and accurate warnings of flash flood induced hazards. This early warning system will also contributing to disaster risk reduction by saving lives and reducing property damages. (WMO, 2016)

The ASEAN Coordinating Center for Humanitarian Assistance on Disaster Management (AHA Center) is an inter-governmental organization aimed at facilitating cooperation and coordination among ASEAN Member States and the United Nations and international organizations for disaster management and emergency response in the Territory ASEAN. The AHA Center is governed by the ASEAN Committee on Disaster Management (ACDM), which comprises the Heads of the National Disaster Management Offices (NDMOs) of ASEAN Member Countries. AHA Center conducts monitoring and dissemination of potential disaster in ASEAN countries. (AHA Centre, 2011)





11.1.2 Interview findings

Based on interviews, 16 of interviewee said there was already regional cooperation in MHEWS implementation. Most of the interviewee is a national respondent. From the interviews most interviewee mentioned IOTWMS (5 Interviewee). I.I.G 01 as host in a meeting with WMO is the only interviewee that know about SAOFFG. Most of the local interviewee are unaware of any regional cooperation in the early warning system. The interviewees' knowledge graphic of regional cooperation in MHEWS is presented in Figure 19.



FIGURE 19. THE INTERVIEWEES' KNOWLEDGE GRAPHIC OF REGIONAL COOPERATION IN MHEWS

"Effectiveness. The ASEAN region is important because we are one community. The technology speed up the collaboration process, through communication we can build the system, a network, regional network in order to reach effectiveness" (I.I.G 04)

Disasters may occurs beyond the administrative boundaries. To improve the effectiveness of the early warning system, regional cooperation is needed to reduce losses. Therefore, the main objective of regional cooperation is to improve effectiveness.

At the local level interviewee, (I.I.A.16) state that there is regional cooperation in place. Such cooperation is in the research and capacity building of the community.

"University conducted regional cooperation in research and capacity building in community. I think the cooperation is quite successful. Now communities are more aware of disaster in their location." (I.I.A.16).

Along with (I.I.A.16), (I.I.N.17) and (I.I.N.18) also stated that cooperation in regional area is quite successful to increase awareness in community.







FIGURE 20. THE CAPACITY DEVELOPMENT NEEDS

From Figure 20 we can see that 1 responded that the capacity of the regional institutions was adequate so there was no need for capacity development. 12 responded to the need for capacity building from cooperating agencies at the regional level. 11 of interviewee answers innovations are needed in MHEWS. Interviewees agree that innovations is a crucial aspect in MHEWS, especially in technical aspect. They agree that better technology can save more people and reduce damage. Needs for innovation in regional cooperation presented in Figure 21.

"Yes it's obvious we need to improve the management capacity through training. We need to innovate the technology because the technology are dynamic. We need to increase the partnership because we can't stand alone." (I.I.G. 08)



FIGURE 21. THE INNOVATION NEEDS IN MHEWS





For the need of training, 10 of interviewee answered that training is needed to improve the quality of regional cooperation. The needs of training to improve capacity in regional cooperation context presented in Figure 22.



FIGURE 22. THE TRAINING NEEDS IN MHEWS

Competence of human resources, technology, and science are gaps that happen in cooperation among Indonesia and other country in the regional. Indonesia has more capability in terms of tsunami detection, climate, meteorology, and volcanoes. For that reason Indonesia through regional cooperation can be a trainer in capacity building in the region.





12. Enablers associated with MHEWS for Coastal Resilience

12.1.1 *Literature Review findings*

The availability of early warning systems is an important element in disaster risk reduction efforts. (Omulo, 2003) mentions some of the contributions and participation of NGOs in the efforts of early warning systems that can be used as enablers associated with MHEW in coastal resilience, such as:

- 1. Information and awareness promotion;
- 2. Preparation of community actions;
- 3. Monitoring and evaluation of natural disasters;
- 4. Partnership building with stakeholders;
- 5. Establishing mechanisms to link communities with policy makers

Another elements of systematic people-centred early warning system stated by (Basher, 2006) which highlight four elements, which are:

Elements	Description
Risk Knowledge	Knowledge of the relevant hazards, and of the
Kisk Kilowieuge	vulnerabilities of people and society to these hazards
Monitoring and Warning Sorvice	A technical capacity to monitor hazard precursors, to
Monitoring and Warning Service	forecast the hazard evolution, and to issue warnings
Discominaton and Communication	The dissemination of understandable warnings, and
	prior preparedness to those risk
Beenenee Canability	Knowledge, Plans and capacities for timely and
	appropriate action by authorities and those at risk

TABLE 4. ELEMENTS OF SYSTEMATIC PEOPLE-CENTRED EARLY WARNING SYSTEM

Source: (Basher, 2006)









FIGURE 23. NATIONAL TO LOCAL EMERGENCY PLANS, LEGISLATION AND COORDINATION MECHANISMS

12.1.2 Interview findings

There are variation of the results interview about enabler of multi hazard early warning system. (I.I.G.01) stated that "it starting with the legal aspects as the "umbrella" of it all, then coordination between all parties. The effectiveness of the MHEWS can be reach when the legal aspects is clear, the coordination is clear, the one that the topics is clear, the arrangement is clear". (I.I.A.12) highlight three enablers which are:

- 1. Accuracy of early warning prediction (technology should be improved);
- 2. Coordination aspect for reaching the last mile community and dissemination of warning information and disaster preparedness; and
- 3. Appropriate action by the community in accordance with the warning information.

From local perspectives, (I.I.G.07, I.I.G.09, and I.I.G.10) are firmly believe that community involvement and culture aspect need to be added in order to effectiveness of the MHEWS. The interview result shows that the awareness/education programmes on MHEWS among key stakeholder and partnership among stakeholder are the major factors which associated with MHEW in Coastal Resilience in Indonesia.

Detailing interview findings, the enablers associated with MHEWS for Coastal Resilience and its rank are as seen in the table below:





Enablers	Interviewee Code/s	Frequency of mentions (i.e. number of interviewees mentioned the particular enabler)	Total Frequency	Rank
Legal aspect and mechanism (Availability of policy, guideline, emergency plan etc to improve	I.I.G.01 I.I.N.17	2 2	4	5
MHEWS)	I.I.G.01	2	4	5
Clear Coordination	I.I.G.04 I.I.A.12	1		
System support	1.1.G.02	4	4	5
Community	I.I.G.02 I.I.G.06	2 3	14	1
Awareness, education	I.I.A.16 I.I.N.17 I.I.P.21	3		
	I.I.P.25	2		
Warning procedure and standard and reach the last mile	I.I.G.03 I.I.G.05 I.I.G.03	1 2 1	6	3
community for appropriate action	I.I.A.12	2		
Preparedness	I.I.G.03 I.I.O.19	1 2 2	9	2
	1.1.0.26	4		
Collaboration and Networking	I.I.G.04 I.I.A.16	2 1 2	5	4
Early detection and hazard monitoring	1.1.G.07 1.1.G.08	3	5	4
Community involvement	1.1.G.09	2	2	7
Culture	I.I.G.10	2	2	7
Science and	I.I.A.11 I.I.A.12	1 1	3	6
rechnology	I.I.P.22	1		
Funding Availability	11 A 16	1	1	8

TABLE 5. ENABLERS FACTORS FROM INTERVIEW FINDINGS

Based on the results related to enablers associated with MHEW in Coastal Resilience, it can be concluded that the enablers factors based on interview results are community knowledge, Awareness, education program on MHEWS among key stakeholders, preparedness, Warning procedure and standard and reach the last mile community for appropriate action,





collaboration and networking, Early detection and hazard monitoring, Legal aspect and mechanism (Availability of policy, guideline, emergency plan etc to improve MHEWS), Clear Coordination, System support, Science and Technology, Community involvement, Culture and Funding Availability.





13. Role of Higher Education Institutes for an Effective MHEWS for Coastal Resilience

13.1.1 Literature Review findings

In Indonesia, Higher Education Institutions has mandate of Three Responsibilities (Tridharma) i.e. education, research and community service. Law number. 12 Year 2012 states that Tridharma is the obligation of Higher Education Institutions to conduct activities of education, research, and community service. Education is a conscious and planned activities to create learning process and atmosphere in order to the learners actively develop their potential to have spiritual power of religion, self-control, personality, intelligence, noble character, as well as skills that needed by society, nation, and country. Research is an activity conducted according to scientific rules and methods systematically to obtain information, data, and information to understanding and /or testing of science and technology. Meanwhile community service is one of higher education dedication to the community by utilizing science and technology to increase society welfare and educate the life of the nation.

In the book "Thoughts and Ideas of Dr. Syamsul Maarif, M.Si on Disaster Management in Indonesia, (Maarif, 2012), stated that HEI's scientists should provide the researches results that contributing toward disaster risk reduction measures including to improve the capacity of communities in disaster management. The HEI should be involved in disaster management due to several reason as follows:

- 1. Disaster management is based on science and technology.
- 2. HEI/Universities have adequate resources to ensure the use of science and technology in disaster management.
- 3. The positions of universities that are considered neutral, and physically located spread throughout Indonesia.
- 4. In line with the Tridarma of Higher Education, i.e. education, research, and community service
 - With education, HEI/universities are expected to perform the role of community intelligence and cultural transmission. The HEI/universities produce leaders who have insight of environmental and disaster risk reduction.
 - Research: able to make new discoveries of science and cultural innovation.
 - Community Service: able to give service to the community to accelerate the process of welfare improvement

These mandate could be used as mechanism of HEI contribution for an effective MHEWS and Coastal Resilience.





13.1.2 Education and awareness programmes: Interview findings

Most of interviewee mentioned that Indonesia has disaster education and awareness programmes both national and local level but it is not specifically to MHEWS. At national level, NDMO/BNPB (I.I.G.04) as a leading institutions in disaster management has various disaster program to increase public awareness and capacity in disaster risk reduction such as establish disaster resilience village in targeted cities/regencies in Indonesia, application of disaster safe school in Aceh, Bengkulu, Pacitan, Minahasa Utara etc, disaster management socialization through cultural approach and mass media and organize disaster exhibition. Another government institutions i.e. BMKG ((I.I.G.02) has also training and education program for selected community such as "climate school for fisherman and farmer", billboard on weather information at harbor area. LIPI (I.I.G.08) and PVMBG (I.I.G.05) are also active in conducting education and awareness program which is in line with their duties and responsibilities.

(I.I.G.07) mentioned that there are 12 universities that already have a partnership with BNPB related to disaster. In Bappenas itself, there is Center of Education and Training, for non-degree training about disaster mitigation, partnership with UGM and Unsyiah in designing curriculum. In the training, early warning system EWS is one of the focus learning.

From HEI's perspective, ITB in example as stated by (I.I.A.11) and (I.I.A.12), has education and research program regarding to special subject on dissemination of disaster information including early warning system development. Under Institute for Research and Community Empowerment, ITB has a continuity education program by conducting several thematic training for government officer, NGO, industries and private sector i.e. training on utilization of weather forecast, climate, maritime for development planning and industry. The industries and private sector also needs accurate information on rainfall prediction for mining activities. The research conducted by ITB are also related to flood and weather forecasting for early warning in order to assist National Disaster Management Organization in developing national system of multi hazard early warning system.

At local level (Padang City and West Sumatra Province), LDMO/BPBD, local university, NGO, school community and private/industries sector have active roles in conducting disaster awareness and preparedness initiatives. Considering West Sumatra is one of earthquake prone area and has experienced large earthquake, there are many initiatives has been conducted in this province. (I.I.L.14) mentioned that BPBD has established disaster resilience group (KSB) in many villages in Padang City and West Sumatera Province. "In this year, the target of KSB development is 71 villages, until now, 63 villages completed and the rest is still undergoing process". KOGAMI (NGO) has succeed to increase awareness and preparedness of school community through facilitating disaster resilience school (SSB) in target school. (I.I.N.17) stated that "we have conducted socialization (outreach) of disaster early detection to the community, not only rely on technology, but synergized it with people's habit." HEI/University involve in training School community and private/industries sector routinely conducted earthquake and tsunami simulation/drill at least twice in a year.





Based on interviewee's opinion, all the stakeholder should be actively participation/involvement in disaster reduction initiatives (including MHEWS education and awareness program) but government is main responsible to handle the program.

13.1.3 *Role of the HEI : Interview findings*

Regarding to the role of HEI, figure below describe statement of respondents about role to be handled by HEI related to MHEWS, i.e.

- Conducting evidence-based MHEWS related research
- MHEWS education
- Increasing awareness in MHEWS
- MHEWS education and awareness programmes for coastal resilience within the region



• Strengthening expertise/advocacy in MHEWS



From the HEI mandate perspective, all the respondents agreed that the role of HEIs for an effective MHEWS and Coastal Resilience could be integrated into mandate of HEIs in Indonesia i.e. Tridharma Perguruan Tinggi.

- 1. Education : produce more experts by implementing disaster program study at undergraduate and post graduate level and conduct education lectures that can be attract interest to study disaster issue
- 2. Research : conduct the disaster research that could be applied at the community level and could be used by government in formulation policies related to disaster issue





3. Community service : conduct the disaster programs and initiatives for the community directly in the form of training, awareness and preparedness program, risk communication, public education, etc

(I.I.G.01) stated that "HEI's can play a role in research and community service by making a study or assessment on impact and magnitude of disaster and the result can be informed then to the community and government." Meanwhile (I.I.G.04) mentioned "In general, HEI is a place of education and research implementation. HEI have data obtained from the research which can be used together and the result of research could become input for policy development regarding to disaster risk reduction, thus the government issued the policy/guideline and standard based on scientific considerations."

Based on (I.I.A.11) statement, HEI is central position because HEI has multi-field of disaster expertise i.e. from geography, environmental engineering, etc. Compare to government institution, HEI is more flexible in playing role to improve MHEW in coastal area. Meanwhile (I.I.A.12) clearly stated that HEI/University has 3 obligations i.e. education, research and community service. In education, university has task to create quality of human resources related to disaster management who will work in disaster institutions, thus they will make the institution better and more reliable in carrying out the task of institution. University is also conduct research by creating new technology in effort to reduce disaster including technology of early warning system. Community service activity is immediately engaging with community in the form of training etc.

All those HEI's mandate should be implemented in collaboration with government and any stakeholder including donors for the programs funding.

In line with national level, at the local perspective majority respondent mentioned that for an effective MHEWS and Coastal Resilience, HEI should conduct more applied research which can respond to community needs, conduct more 'community services' and conduct regular training for disaster risk reduction, i.e. earthquake by HEIs to school or community is highly needed. It is also need coordination between HEIs in conducting research.

The respondent offered the mechanisms could be used to support HEI capacity building for more effective MHEWS:

- Building collaboration between HEI and government in conducting applied research and others disaster resilience initiatives i.e. supporting government in producing guidelines/policies etc with science basis/academic review.
- As a community service university, HEI could give contribution in improving capacity of community in the form of community empowerment programs and activities.
- Establish forums between HEI and government both for sharing result of HEI's researches and giving input to government policies related to MHEWS and disaster resilience
- Sounding and promote disaster education program study of HEI's to attract the students for attending the course.







- HEI should conduct applicative research that can be implemented directly in community
- Need to develop research roadmap or research consortium on MHEWS
- Improve single hazard system to establish MHEWS
- Capacity Mapping of stakeholders to optimize the roles of each institutions in MHEWS

13.1.4 Barriers faced by HEIs : Interview findings

Based on the interviewee statement both at national and local level, the most significant barriers/challenges that prevent HEIs from supporting effective MHEWS are as follows:

Barriers	Interviewee Code/s	Frequency of mentions (i.e. number of interviewees mentioned the particular barriers)	Total Frequency	Rank
Limitation of	I.I.G.03	2	4	1
Limitation of	I.I.A.16	1		
Fulluling	I.I.N.17	1		
Less of research	I.I.G.03	3	4	1
infrastructure	I.I.A.12	1		
(Technology and				
Equipment)				
No preliminary	I.I.A.11	3	3	2
study				
Unclear mechanism	I.I.A.12	2	2	3
Time limitation	I.I.A.16	1	1	4
Coordination and	I.I.A.16	1	2	3
Communication	I.I.N.18	1		

 TABLE 6. BARRIERS FACTORS FROM INTERVIEW FINDINGS

The rank of barriers from the interview findings, are as follows:

- Rank 1 : Limitation of budget/funding and less of research infrastructure (Technology and Equipment) to support HEI's activities
- Rank 2 : There are no preliminary study before conducting initiatives for disaster resilience in community.
- Rank 3 : There are no clear mechanism, coordination and communication for HEI's to support research and others initiatives for establishment and improvement the existing MHEWS and disaster resilience program
- Rank 4 : Time limitation in conducting research and community service due to obligation to teach

The potential solutions to overcome barriers/challenges







- Need to improve leadership for conducting Coordination, Communication and Collaboration among the stakeholders
- Increase the awareness of importance of the technology innovation
- Collaboration between HIE's and private sectors and government





14. Conclusions and Recommendations

14.1 Conclusions

Based on literature review and interviews, the are several findings are related to type of coastal hazards and its impact generated, actions/initiatives related to early warning system and current state for the development of National Multi Hazard Early Warning System, enhancement of coastal resilience, identified key stakeholder in MHEWS and coastal resilience, and the expected role of the HEIs in improving MHEWS and Coastal Resilience:

- Indonesia are prone to many types of coastal hazards, such as tsunamis, earthquake, sea erosion and floods, landslide, windstorms and extreme weather. From these hazards, earthquake and tsunami have the most significant impacts on both number of death toll and the economic losses. For example, 2004 Indian Ocean Tsunami has caused USD 4451.6 Million damage and losses, 110,229 peoples reported dead, and 12,132 people missing, more than 703,518 were displaced. (BAPPENAS, 2005), beside it has caused severe damage and invaluable psychological impact that causing trauma effect toward human lives.
- Indonesia has done several initiatives for disaster risk assessment as initial steps in conducting disaster risk reduction efforts. Standing with the establishment of BNPB National Disaster Management Agency on 2008. Then in 2012 were BNPB regulation on Disaster Risk Assessment Guideline are issued. In 2013 Disaster Risk Index issued by BNPB. This index is becoming reference for Bappenas in preparing National Mid Term Development Plan (RPJMN 2015-2019) on disaster management sector. By 2015, disaster risk assessments was improved by using 2015 data and produced 1: 250,000 scale of disaster risk map for the whole region of Indonesia. In 2016, BNPB published book of Indonesian Disaster Risk which was based on the results of the 2015 assessment. To support these initiatives, BNPB has also launched software applications to detect and response potential disaster i.e. Ina-Safe and Ina-Risk, Ina-Ware that were developed under collaboration with several international organization such as AIFDR, GFDRR, USAID, PDC etc.
- Government of Indonesia has also developed multi single-hazard early warning system for coastal hazard. In response to Indian Ocean Tsunami on 2004, since 2005 Indonesia developed Ina TEWS (Indonesian Tsunami Early Warning System) and established by November 2008. There are two component of the system, i.e. upstream and downstream, upstream has been developed based on technology while downstream will be very much relied on the local capacity of downstream warning chain to disseminate the warning information in the format of order for evacuation. To follow Ina-TEWS (Indonesia-Tsunami Early Warning System), they were Ina-MEWS (Indonesia-Meteorological Early Warning System) and Ina-CEWS (Indonesia-Climate Early Warning System). BMKG is leading institutions and responsible in the upstream area for those early warning systems. It was expected that these hazard/risk baseline early warning system can constitute one multi hazard early warning system. Several gaps were founded in those multi single-hazard early warning system, i.e.





- a. Technological gaps;
- b. Science gap; Indonesia is more advanced in earthquake, tsunami and volcano. Indonesian Disaster Risk Index (IRBI) in example, is too global (macro scale) to be applied, meanwhile for building coastal resilience, micro scale is needed for all hazard in the local level.
- c. Policy gaps: Ina-TEWS (interfaces and downstream varies from end to end context), Ina-CEWS has not been implemented when associated with potential users e.g. agricultural fields, Ina-MEWS has not been detailed and comprehensive to be implemented in the regions
- d. Social gaps: competence of human resources between national and regional
- Other Indonesia's current position in terms of MHEWS and Coastal Resilience are the following:
 - a. The current effort by BNPB is establishing Multi-Hazard Early Warning System : an integrated warning information flow mechanism from upstream to downstream.
 - b. BNPB (Indonesian NDMO) has a draft of Presidential Decree for National Multi-Hazard Early Warning System in 2017.
 - c. KOMINFO (Ministry of Communication and Informatics) has a MHEWS dissemination program
 - d. BMKG has a Sekolah iklim (Climate School) Program.
 - e. BNPB has program for increasing resilience : Desa Tangguh Bencana / Destana (Disaster Resilience Village), Sekolah Laut (Sea School) , Sekolah Gunung (Mountain School), Sekolah Sungai (River School), Sekolah Tangguh Bencana (Disaster Resilience School)
- All the initiatives related to early warning system for coastal resilience that conducted by Indonesia, are the efforts of Government of Indonesia for participating and implementing global initiatives commitment, such as SFDRR, SDGs and Paris Climate Change Agreement, are in line with national development goals i.e. to protect growth centers from natural disasters and climate change. Thus, global initiatives (SFDRR and SDGs) related to EWS and disaster resilience have also adopted and integrated into National Mid Term Development Plan (MTDP 2015-2019).
- To support the efforts of early warning system for coastal resilience, several related law, regulation, policy and guideline have been published. The umbrella of law for disaster management plan and implementation in Indonesia is law no.24/2007 on disaster management. Early warning is part of disaster management in the phase of situation with potential disaster. Another Law is Law 31 of 2009 on Meteorology, Climatology and Geophysical which become basis for role, task and responsibility of BMKG as a leading institutions in upstream area of early warning system. BMKG has also developed and issued The National Guideline on Tsunami Warning Services in 2012 updated in 2016. The guideline provides official information regarding the Indonesian Tsunami Early Warning System (InaTEWS). In the downstream component, several guidelines for disaster resilience program are published by BNPB such as DESTANA-Desa Tangguh Bencana (Disaster Resilience Village), Disaster Safe School, and Communities Participation in Disaster Management etc that could be used as a mechanism to improve the community capacity in responding tsunami warning.
- The main enablers factor associated with MHEWS in Coastal Resilience:





- Community knowledge, awareness campaign, education program on MHEWS among key stakeholders
- Preparedness program
- Legal aspect and mechanism : availability of policies, guideline, emergency plan etc to improve MHEWS
- Clear coordination
- System support
- Early detection and Hazard monitoring
- Warning procedure and standard and reach the last mile community for appropriate action
- Collaboration and networking,
- Community involvement,
- Culture
- Science and Technology
- Funding availability.
- HEIs plays important roles in DRR initiatives planning and implementation to improve MHEWS for Coastal Resilience. As mandated in Law No. 12 Year 2012, HEIs have been mandated with Three Responsibilities (Tridharma) i.e. education, research and community service.

14.2 Recommendation

From the conclusions, the recommendations that may be given for Multi-Hazard Early Warning Systems (MHEWS) for coastal resilience are listed below:

- It should be increasing stakeholders' (including Policy makers) role in addressing the current gaps in technological, science gap, policy gap and social gaps. The stakeholder involvement can be categorized into upstream, interface and downstream level. The need for synergy and collaboration / coordination among these stakeholders are as follows:
 - a. Upstream stakeholders: BMKG, BPPT, BIG, BBWS
 - b. Interface stakeholder: BNPB, TNI, Polri, TV, Radio, KOMINFO, KEMENDAGRI
 - c. Downstream stakeholder: The mayor gets to the community, agriculture and fisheries sector, etc
- The technology and equipment are also should be advanced in current early warning system establishment such as technology involved in making system, tsunami database, decision support system, SOP, Tsunami Risk Assessment, evacuation plan, creating patent for disaster industry, radar technology, flood maps etc.
- In order to fill the science gap, need scientist to work on micro scale such as IRBI that should be downscaled into micro scale area for all hazard to be applied building coastal resilience need. The HEI can also conduct the disaster research that could be applied at the community level and could be used by government in formulation policies related to disaster issue.
- The actions/initiatives including norm, standard, policies, regulation and current efforts from Indonesia are still needed to be continued and sustained for strengthening disaster



awareness and preparedness including to improve hazard/risk base early warning system for coastal resilience. There are success and un-success stories to become lesson learned for implementing DRR initiatives in the future. The evaluation of DRR implementation in Indonesia need to be conducted in order to give input in developing National Multi Hazard Early Warning System policy, initiated by BNPB and other line ministries/institutions. Currently, the Presidential Decree on National Multi Hazard Early Warning System has been drafted and will be processed to establish the system.

- In term of social gaps, the need of competence of human resources between national and regional. HEI could produce more disaster experts by implementing disaster program study at undergraduate and post graduate level and conduct education lectures that can be attract interest to study disaster issue. Other than that, HEI also can play roles in conducting the disaster programs and initiatives for the community directly in the form of training, awareness and preparedness program, risk communication, public education, etc
- To continue and sustain DRR initiatives in Indonesia, it is also needed a regional cooperation and role of HEI in improving MHEWS for Coastal Resilience. Regional cooperation has been done during this time, need to be further followed up and enhanced in various sector of disaster management including in preparation and development of National Multi Hazard Early Warning System. ICG/IOTWMS, WMO, AHA Center ACDM are among Indonesia government commitment at regional level in developing and implementing DRR initiatives in Indonesia.
- As mandated in Law No. 12 Year 2012, HEIs have been mandated with Three Responsibilities (Tridharma) i.e. education, research and community service. These mandate could be used as mechanism of HEI contribution for developing and improving effective MHEWS for Coastal Resilience, for example in the form of conducting evidencebased MHEWS related research, MHEWS education, increasing and awareness for coastal programmes resilience within the region and strengthening expertise/advocacy in MHEWS. HEI's mandate should be implemented in close collaboration with government and any stakeholder including donors for the programs funding.
- Contributions and participation of HEI and other stakeholders in the efforts of early warning systems could be carried out through several enablers factors associated with MHEWS for coastal resilience, such as community knowledge, awareness campaign, education program on MHEWS among key stakeholders; preparedness program; legal aspect and mechanism : availability of policies, guideline, emergency plan etc. to improve MHEWS; clear coordination; system support; early detection and Hazard monitoring, warning procedure and standard and reach the last mile community for appropriate action; collaboration and networking; community involvement, culture, science and technology and funding availability.





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The following table lists all the policies, guidelines, national/local report available for MHEWS in Coastal Resilience. Please fill in as much information as possible.

Name of the Document i.e. Policy, Guideline, National Report, etc.	Document Reference i.e. Author(s)/Institution Name, Year of Publication, Web Source (if online)	Brief Description of the Document i.e. What is it about, it's main purpose, Why was it introduced, is the document aimed at at National Level/ Regional Level/ City Level/ Village Level/ any other, etc.	Main initiatives/Actions highlighted in the Document This can be in the form of bullet points and you have to highlight ONLY the main initiatives/actions stipulated in the document.	Key Informants (if given) If there is a list of key people involved in the development of the document, you can list them here in (their name, position and contact number/e-mail. This will be helpful when you start your Interviews
LITERATURE REVIEW FI	NDINGS			
Disaster Management Law no. 24/2007	President of Republic Indonesia	The purpose to provide basis of disaster management implementation in Indonesia covered values, institutions, distribution of authority and rule of law	 a. Consist of 13 chapter. Chapter 1 deals with general provisions, where the definition of disaster is discussed. The disaster in this law is divided into three, namely natural disasters, non-natural disasters and social disaster b. Chapter II explained that disaster management should be based on several principles, also explained the purpose of disaster management is to provide protection to the community from the threat of disaster c. Chapter III describes the responsibilities and authorities of the government, as well as the determination of the status and level of disaster. 	







			d.	Chapter IV describes the institutional	
				framework (BNPB and BPBD)	
			e.	Chapter V explained rights and obligations of	
				the community towards disaster management	
			f.	Chapter VI discusses the role of business and	
				international institutions in disaster	
				management	
			g.	Chapter VII discusses the implementation of	
				disaster management	
			h.	Chapter VIII discusses the funding and	
				management of disaster relief	
			i.	Chapter IX discusses the supervision on	
				donations.	
			i.	Chapter X concerning dispute settlement is	
			Ĩ.	pursued based on the principle of consensus	
				deliberation	
			k.	Chapter XI discusses criminal provisions	
			1.	Chapter XII discusses transitional provisions	
			m.	Chapter XIII closure	
Ina TEWS-Tsunami Early	BMKG, 2012	The purpose to provide official	a.	The warning chain from national to local levels,	
Warning Service Guidebook		information regarding the	b.	The sequence and content of warning	
(BMKG, 2012)		Indonesian Tsunami Early		messages - including recommendations on	
		Warning System (InaTEWS)		reaction to local authorities	
			c.	Clarification on the roles, responsibilities and	
				procedures of all relevant bodies	
Tsunami Disaster Risk	Indonesia	The purpose to provide guidance	a.	Strengthen chain of tsunami early warning by	
Reduction National Master	National Disaster	in implementing Tsunami Disaster	•	development of sirenes, information,	
Plan 2013-2017	Management	Risk Reduction		earthquake detections, etc.	
	Authority/BNPB,		b.	Development and increase of temporary	
	2013			evacuation shelters by development of	
				shelters, evacuation routes, signages,	
				socializations	







			C.	Strengthen capacity in preparedness and DRR by development of EOC's, risilient villages, trainings, exercises, logistics, equipment,	
				Contingency plans	
			α.	Development of self-suffice business	
Derlie no. 1 (2012 on The	lu de u e ele	The summers to survide suideness	The	Institutions by institutientation industries, sivie	
Perka no. 1/2012 on the	Indonesia National Diseator	The purpose to provide guidance	Ine	Charten Untre guidelines :	
development of "Desa	National Disaster	for government and / or local	a.	Chapter I Introduction (Background, Objectives,	
Tangguh Bencana	Management	government in developing		Legal Basis, General Provisions, Scope and	
(Destana)"	Authority/BNPB,	Destana as part of CBDRM effort		Systematics)	
	2012	and to provide reference for all	b.	Chapter II Policy and Strategy (Policy, Strategy).	
		the stakeholder in development	с.	Chapter III Disaster Resilience Villages	
		of Destana		(Principles: General Criteria: Role of	
				Government at Provincial, District / City Level,	
				District)	
			d.	Chapter IV Activities in Developing Disaster	
				Resilience Villages (Risk Assessments, Disaster	
				Management Planning and Contingency	
				Planning, Establishment of DRR Forum,	
				Increased Community and government officer	
				Capacity in disaster management, Integration	
				of DRR into Village Development Plans / Legal	
				aspect, Implementation of DRR in village,	
				Monitoring, Evaluation and Reporting Program	
				at Village level).	
			e.	Chapter V Closure.	
Perka no. 17/2011 on The	Indonesia	This document contains the rules	sa.	This rule consists of 8 sections. The first chapter	
volunteer development	National Disaster	for volunteers in disaster	r	contains background and scope of the	
based on cluster	Management	management. This guideline wil	I	guidelines. This chapter also explain about the	
	Authority/BNPB,	regulate the role, rights and	ł	definition of terms' used in the document.	
	2011	obligations of volunteers ir	۱b.	Chapter II contains the volunteer work	
		performing volunteerism ir	۱	principles, rights, obligations, skills that	
		disaster during the emergency	/	volunteers must possess, consequences and	



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response period, and during post-	-	rewards. The skills of disaster volunteers	
disaster rehabilitation –	-	including 26 points such as the ability to provide	
reconstruction.		emergency facilities, disaster loss assessment,	
		evacuation capability, mapping, counseling,	
		medical skill, and other supporting skills.	
	c.	Chapter III contains the role of volunteers in	
		disaster management. The role of volunteers in	
		pre disaster includes mitigation and training.	
		The role of volunteers in potential disaster	
		event is preparedness and early warning. The	
		volunteer's role during the emergency	
		response includes a rapid assessment of	
		damage, provision of basic facilities, counseling,	
		evacuation, and protection of vulnerable	
		groups. In post-disaster conditions, the role of	
		volunteers is to assist in physical and non-	
		physical rehabilitation and reconstruction	
		activities	
	d	Chapter IV contains volunteer data collection	
	ч.	This section describes steps of volunteer data	
		collection and recognition of volunteer skills	
		Chapter V contains volunteer training including	
	с.	compotencies institutions leadership and	
		notworking This section describes the	
		institutions that have the authority to give	
		institutions that have the authority to give	
		training.	
	т.	Chapter VI describes the SUPS before and	
		during volunteers working in the field.	
	g.	chapter vi explain about monitoring and	
		evaluation. This section describe about the	
		objectives and methods of volunteer	
		performance evaluation. After monitoring and	
		evaluation is done, there is a guide to the next	







			step that can be taken based on the results of	
			monitoring and evaluation.	
		h.	Chapter VIII contains conclusion of the	
			documents.	
Perka no. 4/2012 on	Indonesia	This document contains the a.	This document consists of 6 chapters and 1	
Disaster Safe School	National Disaster	elements that considered in	attachment. Chapter I contains backgrounds,	
(Sekolah/Madrasah Aman	Management	establishing a disaster-safe school.	legal bases, and explanations of some of the	
Bencana)	Authority/BNPB,	The guidelines provide tools for	terms used in the document.	
	2014	assess school's capacity toward b.	Chapter II describes earthquakes and tsunami	
		earthquake and tsunami.	hazard and zoning in Indonesian, and steps that	
			can be taken as school's preliminary	
			assessment toward disaster.	
		c.	Chapter III contains the basic application of	
			disaster-safe schools. This chapter describes	
			the elements to be considered in the	
			implementation of disaster-safe schools such as	
			cultural values, local wisdom, and inclusiveness.	
			It also explains the principles, strategies, and	
			role-sharing of stakeholders in the	
			implementation of disaster-safe schools.	
		d.	Chapter IV contains structural and non-	
			structural frameworks. The structural	
			framework is the physical construction of	
			schools to reduce disaster risk. The non-	
			structural framework is an effort to include	
			regulatory, community awareness campaigns,	
			education and preparedness training for school	
			members. Also explained are the parameters,	
			indicators, and structural and non-structural	
			assessments.	
		e.	Chapter V contains monitoring, evaluation and	
			reporting of safe school implementation. This	







			f. g.	chapter describes the legal basis for monitoring, evaluation and reporting. Chapter VI contains a closing statement. The last section contains an attachment of the earthquake and tsunami risk index. In addition, the appendices contain documents assessing the physical and non-physical vulnerability of schools.	
Perka no. 13/ 2014 on Gender mainstreaming on disaster management	Indonesia National Disaster Management Authority/BNPB, 2014	This document describes gender mainstreaming in the planning, budgeting, and implementation of disaster management. This document provides guidance on vulnerable groups in the gender context and gender-based participation that can be undertaken in disaster management.	a. b. c.	This document consists of 8 chapters. Chapter I contains the terms used in the document. Chapter II contains the purpose of this rule. It also explains the regulatory framework that includes gender mainstreaming in pre-disaster, emergency response, and post-disaster. Chapter III contains the organization of gender mainstreaming. This section explained that the implementation of gender mainstreaming activities should be listed in the APBD (local revenue and expenditure budget). In the implementation of gender mainstreaming, there is a working group in the activity. The groups coordinate with the National Disaster Management Agency (BNPB) in gender mainstreaming, advocacy, and socialization. Chapter IV describes gender mainstreaming during pre-disaster. These include risk assessment, early warning, mitigation, and gender responsive preparedness. In this chapter described gender roles in pre-disaster can be optimized by providing right support mechanism.	

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			e.	Chapter V contains gender mainstreaming	
				during emergency response. This chapter	
				describes the basic needs fulfillment,	
				temporary shelters, clean water and sanitation	
				needs, education services, and security. This	
				chapter explained that vulnerable groups in	
				gender mainstreaming in disasters are female	
				that become a head of household male	
				without wife and pregnant and lactating	
				mothers.	
			f.	Chapter VI contains gender mainstreaming in	
				the post-disaster. Recovery efforts in this	
				chapter include physical, social and economic.	
			g.	Chapter VII contains stakeholder cooperation	
			Ĭ	and capacity building. This section describes the	
				cooperation between NDMA / LDMO with	
				institutions, ministries, universities, NGOs,	
				private sector, mass media, and others in	
				gender responsive programs.	
			h.	Chapter VIII is closing statement.	
Perka no. 14/ 2014 on	Indonesia	This document describes the	a.	This rule consists of 5 chapters. The first chapter	
Disabilities protection and	National Disaster	protection and rights of persons		describes the terms used in documents and the	
management on disaster	Management	with disabilities in pre-disaster,	,	purpose of document formation.	
management	Authority/BNPB,	emergency and post-disaster	b.	Chapter II contains the handling and protection	
	2014	conditions.		of people with disabilities. NDMA / LDMO is	
				required to establish a special service unit for	
				people with disabilities in disaster	
				management. This chapter describes the tasks	
				of the disability service unit including planning	
				policies, programs, and handling activities and	
				the protection of people with disabilities.	
			c.	Chapter III contains the fulfillment of the rights	
				and needs of people with disabilities include	







				physical and non-physical access. Physical	
				accessibility include standardized facilities and	
				infrastructure, while non-physical access	
				includes information and prioritization in	
				services. This chapter describes early warning	
				systems should reach people with disabilities.	
			d.	Chapter IV contains a statement that this	
				regulation should be considered in disaster	
				management and disaster risk reduction plan.	
			e.	Chapter V contains the closing statement.	
Perka BNPB No 11/ 2014 on	Indonesia	This document regulates	a.	This document contains 7 chapters. The first	
Communities participation	National Disaster	community participation in		chapter describes the terms used in documents	
on disaster management	Management	disaster management, both as		and the purpose of document. This chapter also	
	Authority/BNPB,	individuals and community		explain the rights and roles of communities in	
	2014	organizations. This document also		disaster management.	
		explained about rights,	b.	Chapter II contains the procedures for	
		prohibitions, and mechanisms of		community organization in disaster	
		participation.		management. This chapter describes the	
		P P		participation of community organizations in pre	
				and nost-disaster activities and provision of	
				assistance to community organizations during	
				the emergency response period	
			~	Chapter III contains the implementation of	
			c .	community participation. This section describes	
				the obligations and prohibitions of individuals	
				the obligations and prohibitions of individuals	
				and community organizations in implementing	
				disaster management activities.	
			d.	Chapter IV contains monitoring, reporting, and	
				rewarding mechanism for the role of	
				community organizations. This chapter	
				explained the purpose of these three things is	
				to ensure the effectiveness of the community's	
				role in disaster management.	





			e.	Chapter V contains the establishment of networks of community organizations with local government and other organizations.	
			f	Chanter VI contains the role sharing among	
				stakeholder and chanter VII contains the closing	
				statement.	
Perka BNPB No 12/ 2014 on	Indonesia	This document regulates business	a.	This document contains 7 chapters. The first	
Private sector participation	National Disaster	institution's participation in		chapter discusses the terms used in the	
on disaster management	Management	disaster management. This		documents of the role of business institutions	
	Authority/BNPB,	document also explained about		in disaster management. Described in this	
	2014	rights, obligations, prohibitions,		section are activities that can be undertaken by	
		and participation mechanisms.		business institutions in disaster mitigation	
				efforts, such as disaster risk identification and	
				monitoring, participatory planning,	
				development of disaster awareness early	
				warning system management and evacuation	
			h	Chanter II contains the role of husiness	
			.	institutions in disaster management. In the pre-	
				disaster and nost-disaster husiness	
				organizations must have a memorandum of	
				understanding terms of reference, and activity	
				plan. The format of the Moll is given by NDMA	
				/ LDMO In emergency response activities	
				husiness institutions can provide assistance	
				through NDMA / DMO	
				Chapter III contains the implementation of the	
			c.	chapter in contains the implementation of the	
				role of business institutions. This chapter	
				explained about the rights, obligations and	
				restrictions in the provision of assistance in	
			Ι.	disaster management activities.	
			d.	Chapter IV contains monitoring, reporting, and	
				rewarding mechanism for the role of business	
				institution.	













f. Chapter VI discusses data management
g. Chapter VII discusses the meteorology,
climatology and geophysics services,
information services, service providing and
prices
h. Chapter VIII discusses the liability of
information usage
i. Chapter IX discusses facilities and
infrastructure.
j. Chapter X discusses on climate change that
the government is obliged to mitigate and
adapt to climate change by formulation of
national policies, strategies, programs, and
control activities for climate change;
coordination of control activities for climate
change; and implementation monitoring and
evaluation policy on the impact of change
climate
k. Chapter XI concerning international
cooperation in the aspect of meteorology,
climatology and geophysics
I. Chapter XII concerning research, engineering
and development in the aspect of
meteorology, climatology and geophysics
m. Chapter XIII discusses human resources
needed in the field of meteorology,
climatology and geophysics
n. Chapter XIV discusses on rights and obligation
of community in the field of meteorology,
climatology and geophysics
o. Chapter XV on criminal provisions
p. Chapter XVI discusses transitional provisions
q. Chapter XVII closure





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2.	Ina TEWS-Tsunami Early	BMKG, 2012	The purpose to provide official	a.	The warning chain from national to local levels,	Stated by interviewee no
	Warning Service		information regarding the	b.	The sequence and content of warning	(I.I.G.02), (I.I.G.10), (I.I.A.11)
	Guidebook (BMKG,		Indonesian Tsunami Early		messages - including recommendations on	
	2012)		Warning System (InaTEWS)		reaction to local authorities	
				c.	Clarification on the roles, responsibilities and	
					procedures of all relevant bodies	
3.	Perka BNPB, No 2/2012,	BNPB, 2012	The purpose to provide guideline/	a.	This rule consists of 8 chapters. The first	Stated by interviewee no
	General Guideline for		reference for Ministries /		chapter introduction discusses about	(I.I.G.04), (I.I.A.12)
	Disaster Risk		Agencies, Local Governments and		background, purpose, scope and definition of	
	Assessment		Community in Indonesia in		the terms used in documents	
			implementing disaster	b.	Chapter II Conception, explained general	
			management programs		concept, principles, function, position the	
					guideline in other methods of assessment,	
					relation of assessment at city, provincial and	
					national level, and duration of assessment.	
				с.	Chapter III contains general method	
				d.	Chapter IV contains method of index	
					calculation	
				e.	Chapter V discusses disaster risk assessment	
					covered disaster risk mapping and disaster risk	
					assessment	
				f.	Chapter VI contains disaster management	
					policy arrangement	
				g.	Chapter VII contains presentation of disaster	
					risk assessment and disaster risk map	
				h.	Chapter VIII closing statement.	
4.	Book of Disaster Risko	BNPB, 2016	The purpose to provide	a.	The disaster risk assessment discussed in this	Stated by interviewee no
	in Indonesia (Risiko		guideline/reference and		book is general assessment with analysis scale	(I.I.A.12)
	Bencana Indonesia)		preliminary information in		for national and provincial level but could	
			conducting disaster risk reduction		represent general description at regency/city	
			efforts. Disaster risk is becoming		level	
			basis in developing Disaster			






			Management Plan, Contingency Plan, Spatial Plan and others.	b.	The approach used in disaster risk assessment based on hazard, vulnerability and capacity	
5.	Draft of Presidential Decree on National Multi Hazard Early Warning System	President of Republic Indonesia	It is expected that the presidential decree will provide guidance on management of early warning system in one national system and multi hazard; and provide legitimation in giving guidance for evacuation which easily understood by community	a. b.	The development of presidential decree is based on the need for monitoring and early warning services of multi hazard, due to currently the early warning is only available for single hazard and it is not yet integrated into national multi-hazard early warning system that easily understood by the community. The content of presidential decree will consist of 6 chapter (General Provisions, Procedures for the Implementation, National Multi Hazard Early Warning System, Rights and Obligation of Community, Transitional Provisions and Closing Provisions). The content will also covered organization structure of National Multi Hazard Early Warning System, risk knowledge, monitoring and forecasting of disaster threat , analysis of disaster threat and risk, warning dissemination to the community and strengthening disaster preparedness of community (including rights and obligation).	Stated by interviewee no I.I.G.06
ь.	Assessment for the City in 2015	and Spatial Plan	ine purpose to provide guideline in conducting city resilience assessment	a. e.	in terms of spatial arrangement and has 101 criteria of resilience The guideline has applied in 2016 in several cities i.e. Balikpapan, Bandung, Malang, Tangerang, Depok and Surabaya	Istated by interviewee no I.I.G.09









---- End of Report ----