

COASTAL DISASTER MITIGATION IN INDONESIA

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ABSTRACT: The rate of population growth and magnitude of development along Indonesian coast presents many challenges. One of these challenges is to ensure the safety and security of a population and facilities that is periodically subjected to catastrophic coastal disasters. Significant initiatives are under way to minimize the impacts from coastal disasters through better preparedness and a more informed public.

This paper presents the implementation efforts to mitigate coastal disaster in Indonesia. Structural counter measure and non-structural counter measure were developed to mitigate coastal disaster. The coastal environment are very sensitive and dynamic, therefore all of development of coastal disaster mitigation should be designed and planned in the integrally with the Integrated Coastal Zone Management (ICZM) concept.

1. INTRODUCTION

Indonesia is both blessed and threatened by nature. Due to our size, extending over 3 times zones and more than 6.000 km from east to west, to our location between the Philippine Sea and the Indian Ocean, and to our geologic setting, we are blessed with what is considered by some to be the greatest marine biodiversity within a single nation. We are tasked with being good stewards of this global resource whose importance and management we as a planet just beginning to understand. This blessing is balanced by nature as we are also threatened with almost every coastal disaster known, including explosive volcanoes, earthquake and tsunamis, most of which directly impact to our coastal populations and resources. Our culture has accepted this dichotomy with nature, reflecting her diversity in our traditions and acknowledging her might during natural disasters.

One of the explanations often provided for the significant increase in the amount of disaster damages is the population increase in disaster-prone locations, including coastal areas. Every year, more and more Indonesian are at risk from a variety of natural disasters that affect the coastal environment. In the past 20 years, there has been such explosive growth along the nation's coastal margins that today more than 60 % of Indonesian population live in the coastal area, and more than 80% of industrial area, 75% of main cities with the population more than 100.000 people and 60.000 villages are in the coastal area. Many of the development activities take place in the coastal area such as fisheries, agriculture, industry, transportation, tourism, urban development, that are particularly vulnerable to catastrophic and chronic coastal disasters, such as tsunamis.

The rate of population growth and magnitude of development along our coast presents many challenges. One of these challenges is to ensure the safety and security of a population and facilities that is continually threatened by natural disasters and periodically subjected to catastrophic disasters. Significant initiatives are under way to minimize the impacts from coastal disasters through better preparedness and a more informed public.

2. COASTAL DISASTER IN INDONESIA

2.1 Tsunami

The world was made frighteningly more aware of the danger associated with population centres located near coastal areas as Indonesia devastating loss of live and setback of economic development due to tsunami disaster.

Most of the tsunami that happen in Indonesia caused by tectonic earthquake along the subduction zone and active seismic area. As recorded, from period of 1600 – 2005 there were 107 tsunami events which 90% of them caused by tectonic earthquake, 9 % caused by volcanic eruption, and 1 % caused by landslide.

The most catastrophic one was tsunami caused by the Sumatera Earthquake 2004. Sumatera Earthquake 26 December 2004 generated giant tidal wave which hit coastal area and small islands not only in NAD (Nangroe Aceh Darussalam) and North Sumatera provinces of Indonesia, but also attacked Malaysia, Srilangka, Thailand, India, Maldive, and Africa. Its run-ups were reported higher than 30m, more than 300,000 lives were lost.

The 26 December 2004 Tsunami disaster in Indonesia was massive, record breaking level earthquake and tsunami. The damage and losses incurred reflect the massive earthquake and the ensuing waves that very rapidly reached its coasts affecting the northwest and east coast of NAD and North Sumatra provinces. There was very short almost no time for alert and evacuation.

Another example are tsunami at Flores (1992) caused more than 1950 people died, tsunami caused by earthquake at East Java Jawa (1994) caused 240 people died, and tsunami at Biak (1996) caused 107 people died. The other most catastrophic tsunami was caused by the eruption of Krakatau in 1883. The Krakatau Eruption generated giant tidal wave wich hit coastal area and small islands around Sunda Strait. Its run-ups were reported higher than 30m, more than 36,000 lives were lost.

Some of Indonesian coastal areas that threatened by tsunami are west coast of Sumatra, South coast of Java, North coast and South of Nusa Tenggara, islands of Maluku, North coast of Papua, and most of Sulawesi (Celebes) coast. Table 1 shows tsunami cases in Indonesia during 1960-2005

Table 1. Tsunami cases in Indonesia during 1960-2005

NO	YEAR	EPICENTRUM	MAX RUN -UP (m)	TOTAL IMPACT (died/injured)	LOCATION
1.	1961	8,2 Lat. S; 122 Long.E.	NA	2 /6	NTT, Flores Tengah
2.	1964	5,8 Lat. N; 95,6 Long.E	NA	110/479	Sumatra
3.	1965	2,4 Lat.S; 126 Long.E	NA	71 died	Maluku, Seram, Sanana
4.	1967	3,7 Lat.S; 119,3 Long.E	NA	58/100	Tinambung Sulsel
5.	1968	0,7 Lat.N; 119,7Long.E	8 – 10	392 died	Tambo Sulteng
6.	1969	3,1 Lat.S; 118,8 Long.E	10	64/97	Majene Sulsel
7.	1977	11,1Lat.S; 118,5Long.E	NA	316 died	NTB, Pulau Sumbawa
8.	1977	8 Lat.S; 125,3 Long.E	NA	2 /25	NTT, Flores, P. Atauro
9.	1979	8,4 Lat.S; 115,9 Long.E	NA	27/200	NTB,Sumbawa, Bali,Lombok
10.	1982	8,4 Lat.S; 123 Long.E	NA	13/400	NTT,Larantuka
11.	1987	8,4 Lat.S; 124,3 Long.E	NA	83/108	NTT, Flores Timur, P. Pantar
12.	1989	8,1 Lat.S; 125,1 Long.E	NA	7 died	NTT, P. Alor
13	1992	8,5 Lat.S; 121,9 Long.E	11,2 – 26,2	1952/2126	NTT,Flores, P. Babi
14.	1994	10,7Lat.S; 113,1Long.E	19,1	38/400	Banyuwangi Jatim
15.	1996	1,1 Lat.S; 118,8 Long.E	NA	3/63	Palu Sulteng
16.	1996	0,5 Lat.S; 136 Log.E	13,7	107 died	P. Biak, Irian Jaya
17.	1998	2,02 Lat.S; 124,87 Long.E	2,75	34 died	Tabuna Maliabu Maluku
18	2000	1,11 LS; 123,5 BT	3	4 died	Banggai
19	2004	3,298 LU; 95,779 BT	34,5	>200.000 died	NAD, North Sumatera,
20	2005	2,065LU; 97,010BT	3,5	N/A	Nias

2.2 Flooding

Flooding is a classical problem, and hard to be solved. It caused by uncontrolled the huge expanding the coastal cities as central for business and economic growth. Generally, flooding was occurred in absence adequate drainage, massive building along the coastline, land based waste, deforestation along the watershed areas and catchments areas, reclamation, siltation in estuaries and land subsidence. All the factors change the hydrological process and river flow as well as loss of catchments area and increase the surface run-off.

Flooding is a source of damage of infrastructure and loss of settlement, agriculture sites, and ponds. It also increases the erosion and sedimentation to coastal zones. It is identified that Jakarta, Northern coast of Java, Lampung, Palembang, Aceh, West Sumatra, Manado, Minahasa, and Sumbawa Island are high potential area to flooding.

2.3 Sea Level Rise

Green house effect has made global warming that impact to sea level rise. According to IPCC (1990), it is predicted that SLR will reach 1 meter in 2100. Based on this scenario, Indonesia will be lost about 4.000 Ha of land due to SLR of 1m.

Sea level rise also will bring more coastal area under inundation. This coupled with reduced flows from upland during dry season will accelerate the saline water intrusion inland. Coastal waters will become more saline and soil salinity will increase. Not only that, even the ground water aquifers will bear the brunt of salinity intrusion.

The rise in sea level and availability of less freshwater particularly during dry season when no rainfall will cause inland intrusion of saline water. As a result, many mangrove species, intolerant of increased salinity, may be threatened. The shrinking of the mangrove areas will have effect on the shrimp production and coastal protection. Increased water salinity may also not be suitable for many fishery species. Sea level rise, by reducing the fresh water fishing area, will cause reduction of fish production. Pond culture in the coastal area will be affected by intrusion of salt water into ponds, unless embankments are made around them.

It is identified that almost coastal zone and small island in Indonesia are vulnerable area to sea level rise.

3. POLICIES AND STRATEGIES FOR COASTAL DISASTER MITIGATION IN INDONESIA

3.1 Integrated Coastal Zone Management Policy

The Ministry of Marine Affairs and Fisheries (MMAF), Republic of Indonesia also pro active to minimize the impact of coastal disaster especially for coastal community and the aquaculture activities overthere. Through the Directorate General of Marine, Coasts and Small Islands, one of the organization under the MMAF, we are continuing to formulate the national policy and programs to mitigate the adverse impact of coastal disaster in Indonesia.

In this context we have 5 programs that support the mitigation of coastal disaster. The program also emphasized on the implementation of Integrated Coastal Zone Management (ICZM). In this ICZM we will try to make a balance between the natural resources, human utilization, and disaster mitigation aspects (Figure 1).

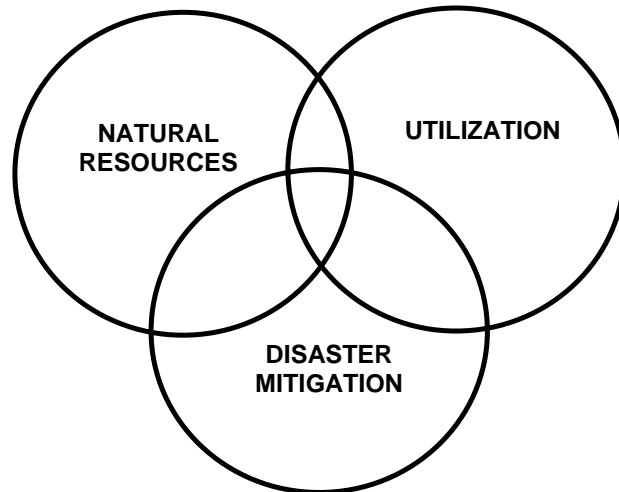


Figure 1. The components of ICZM (Natural Resources, Human Utilization, and Disaster Mitigation)

The disaster mitigation is important component that should be considered for the coastal planners. The good development in the coastal area that build by years can be disappeared just in a minute by a disaster such as tsunami.

ICZM schemes must address both the human and natural elements of the total coastal environment. One objective of ICZM is to preserve the ecological integrity of coastal zone ecosystems. Such ecosystems exist in generally harsh conditions-conditions of strong winds, high salt concentrations, and wide changes in air and water temperature. However, at the same time, nutrient salts supplied from rivers and abundant light in the shallow waters support high primary productivity. Coastal zone management must be sensitive to the nuances of the ecological variables of coastal ecosystems.

A second objective is to aid in appropriate human utilization of coastal areas. Utilization refers to harvesting of fish, shellfish and seaweed, construction of ports, establishment of sites for industry, building of residential homes, and setting aside of recreation areas.

A third objective of ICZM is to prevent excess material damage and loss of life from natural disasters such as earthquakes and tsunamis.

A final objective is to comprehensively integrate separate efforts undertaken to achieve the first three objectives. The purpose of ICZM is to create an attractive, safe, and vibrant coast; an ecologically sound and inspiring landscape.

One of the purposes is to overcome one of the biggest problem of ICZM-the trade offs between the ecological, disaster mitigation, and human utilization. For example, ecosystems are often damaged when seawalls are constructed.

Furthermore, viewing disaster risk as mainly coming from a hazard has thus now been expanded to include a community's vulnerability. The shift in risk reduction strategies has, in addition to being reactive - utilizing early warning, preparedness and emergency management tools, to becoming more proactive - utilizing awareness raising, risk management and risk reduction strategies. Both strategies, when combined, are being envisioned to immensely reduce deaths, as well as social, economic and environmental losses. The framework put forth by UN-ISDR (see Figure 2) encompasses both with sustainable development as the overarching principle. As seen from the diagram, it can now be appreciated that disaster risk reduction and other management programmes like integrated coastal zone management, poverty reduction and good governance have mutually supportive objectives. As with other programmes, disaster risk reduction acknowledges both the social and physical dimensions of the risks, calls for a stronger political commitment and puts significant importance to changing human behavior and attitudes. Strategies are geared towards management of the physical environment (e.g., zoning, mangrove and habitat restoration); promotion of sustainable livelihood, poverty alleviation and promotion of public participation.

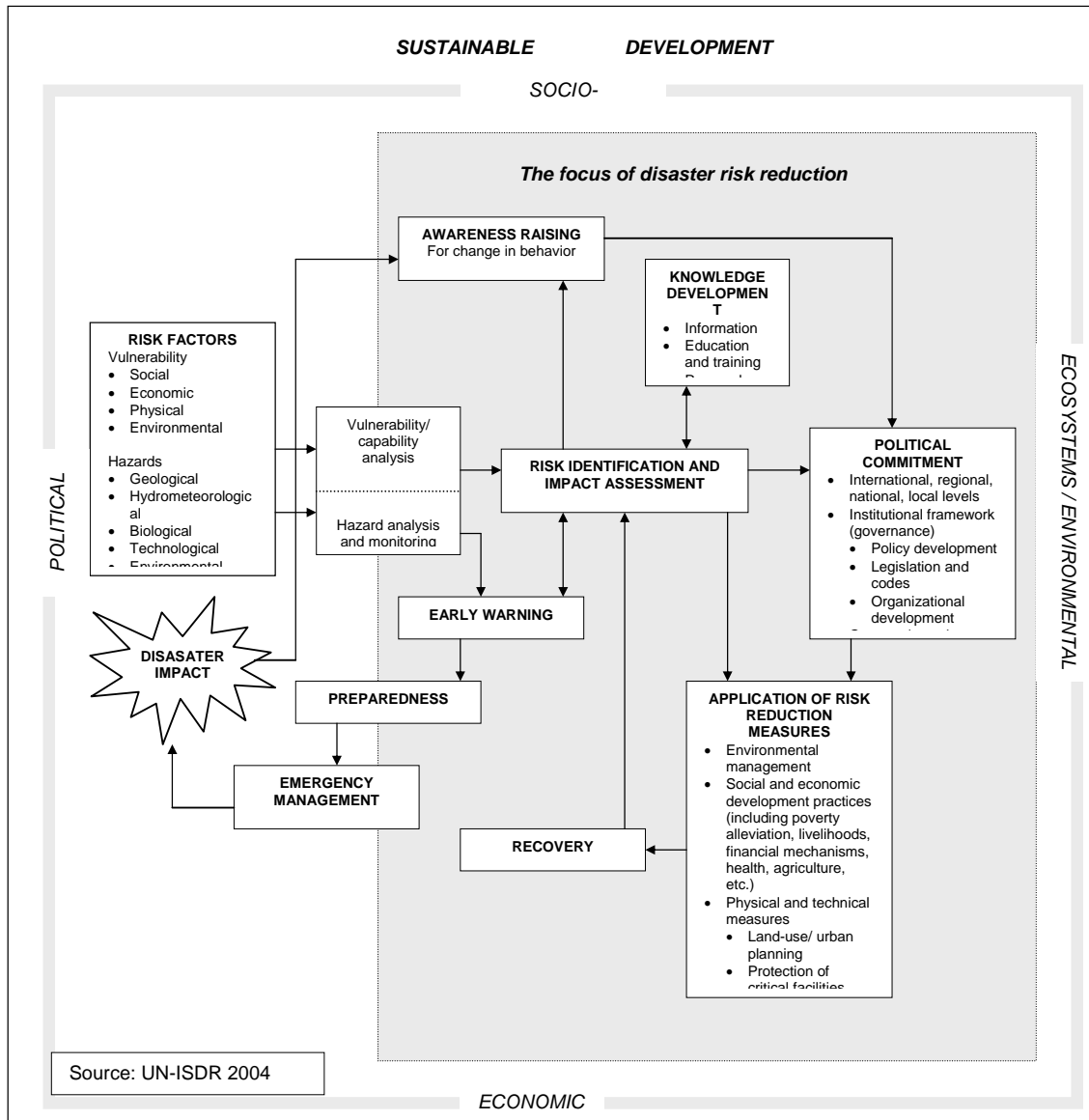


Figure 2. Framework for Disaster Risk Reduction

3.2 Structural Countermeasure

Structural counter measures using natural protection method (soft structure), such as mangrove plantation/green belt along the coasts for erosion and tsunamis threat is being developed. This activity covers replanting of mangrove.

This activity site is located at the coasts in Indonesia which experienced environmental degradation and located in the beach erosion and tsunami prone coastal area. This site was originally a pristine mangrove forest that was then subjected to commercial cutting and conversion to shrimp pond and settlement in the early 1980s. These activities led to coastal erosion and tsunami attack, with an estimated subsequent loss (retreat) of coastal area. Coastal erosion may have been exacerbated by coral extraction as well.

The overall goal of the activity is to re-establish the mangrove greenbelt and reduce the rate of coastal erosion and tsunami attack. The concept that was developed in consultation with the community was to establish three line of defence :

- physical structures in the nearshore zone to cause wave attenuation and accelerate sedimentation.
- Planting of mangrove seedlings in coastal area, where they will be protected; and,

- Planting mangrove seedlings in the area between the beach and the structures, where there is some protection and accelerated sediment accretion.

Training was given to the community to educate them how important of the mangrove forest is both in economical and ecological aspect, and in planting mangrove seedlings.



Figure 3. Mangrove Plantation in Indonesia to Mitigate Erosion and Tsunami

3.3 Non Structural Counter Measure

3.3.1. Public awareness

Education, training and awareness building should be considered as an integral part of pre-disaster assessment and mitigation activities. The building of disaster awareness in the general population, starting with the individual, was essential in reducing casualties. Raising public awareness is achieved through various public campaign activities. Workshops are used as the main information dissemination media, covering different types of target such as decision makers and practitioners. The objective of this workshop are :

1. To increase public awareness and knowledge.
2. To strengthen links among key agencies who are responsible for the coastal disaster management.
3. To share experiences and expertise on coastal disaster.
4. To introduce to the people the links between the scientific value of coastal disaster in specific and national plan.
5. To evaluate the progress of the coastal disaster monitoring system.
6. To evaluate the knowledge of the people around the coastal disaster prone area.

And complement those efforts, for children education we already published a comic entitled TSUNAMI. The comic was made based on the real story of local wisdom to evacuate people in Simelue island, NAD province of Indonesia. The Simelue island is small island located between 2°15"-3°00" Latitude and 95°40"-96°35" Longitude, approximately 130 km southwest Sumatera island in Indian Ocean and about 50 km southeast of the earthquake Epicenter. The Simelue island was hit by tsunami generated by Sumatera Earthquake 2004. The tsunami wave height varies between 2-15m. It only takes 5-10 minutes after the receding of the sea levels and the first tsunami waves coming followed by the second wave, which is the highest according to the witnesses that destroy northeast coastal areas, and some other part of the island approximately between 20 minutes to 1 hours. All villages at Alafan district at the northeast that facing to the source of the earthquake and tsunami had been destroyed by the second wave that reach maximum height 15m and at Labuhan Bakti villages at the south end of the island, the maximum wave height had been measured is 4 m and destroyed the whole villages.

With dead toll only 7 people and 1 missing compare with the population of the people who live on this island (total 78.000) apparently had a good knowledge on tsunami. There is a story that always been told to the people who lived on this islands since they are childhood about "SMONG" a local word referring to tsunami that happened in year 1907. They said if you feel the quake where you are on this island, and the sea levels dropped/receded after earthquake, you should immediately run-away to the higher place to save your live. This story had saved a life of people who lived on this island during the 26 December 2004. According to the historical tsunami databases, there was a tsunami occurred on this region in 1907.

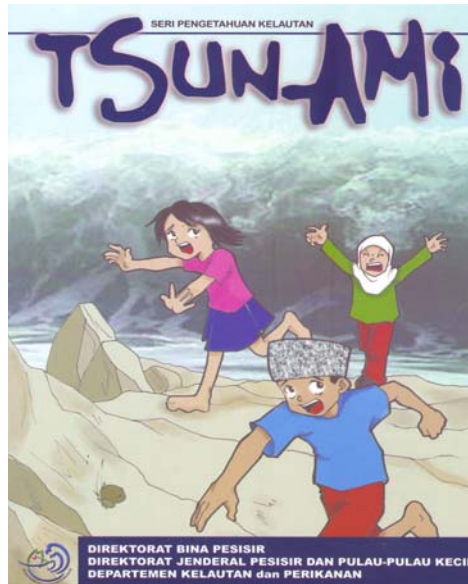


Figure 4. Tsunami Comic

3.3.2. Development of Spatial Use Planning Models for National, Provinces, Districts, Cities and Small Islands.

The Coastal and Small Islands Spatial Use Planning Document, if any, has never taken into account the coastal disaster risks. Policy of coastal spatial use planning is being developed by taking into account of coastal disaster mitigation has to be promoted in order to secure human live from disaster.

3.3.3. Development of National Policy and Guidelines.

This main activities include:

- Formulating national guidelines for Integrated Coastal Zone Management
- Formulating national guideline for Coastal and Small Islands Hazards Mitigation.
- Formulating national guidelines for Coastal and Small Island Spatial Use Plan.
- Formulating Bill for 'Indonesian Coastal Management Act'.

The guidelines for Coastal and Small Islands hazards Mitigation is aimed as the guideline for government, local governments, and communities in disaster management, which cover mitigation in the pre-disaster action. The goals of the guideline are (i) to enhance mitigation efforts in coasts and small islands, (ii) to motivate participation of local governments, private sectors and communities in developing mitigation efforts, (iii) to promote public awareness to disaster mitigation.

3.3.4. The last but not the least is our new Marine and Coastal Resources Management Program that will apply Integrated Coastal Zone Management Policy in 15 Provinces and 45 Districts/Cities.

ICZM process started from the identification of management issues (strategic plan), establishment of zonation plan, formulation of management plan, and establishment of action plan. The coastal environment are very sensitive and dynamic, therefore all of development should be designed and planned in the integrally with the ICZM concept because the development will alter the stability of the fragile ecosystem, change the socio economic situation, and have negative impacts. ICZM concept is being developed by taking into account disaster mitigation in the hierarchial planning of ICZM. In this program, risks and hazards thematic map including tsunami is also being developed in 15 Provinces.

A hazard map was developed using technical data from the historical data and numerical forecasting of tsunami. All information was translated to the GIS platform, significantly refining areas which could easily be inundated and which specific households, in times of emergencies, need to be evacuated immediately. They now use GIS as an effective tool for land-use and urban planning; on the drawing board are areas appropriate for coastal zone development.

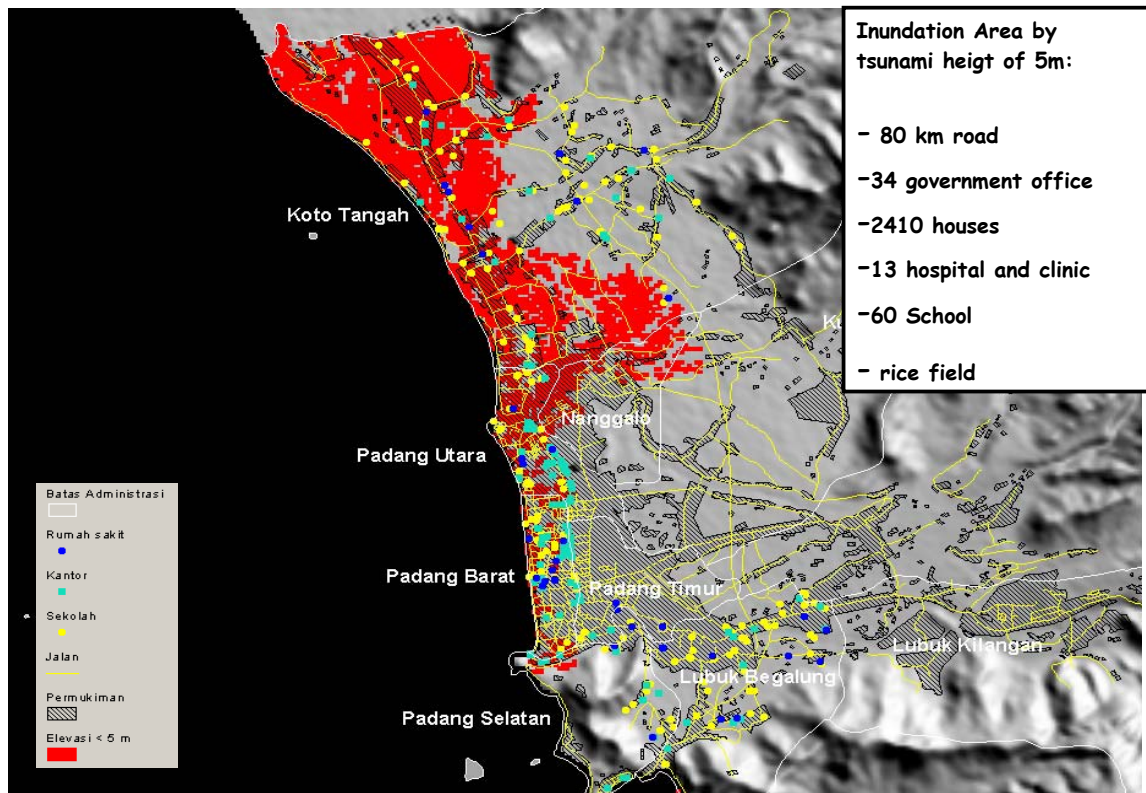


Figure 5. Tsunami Hazard Map in Padang City, West Sumatera Province of Indonesia

3.4 Coastal Community Empowerment

Coastal areas in Indonesia are under heavy pressure. This pressure has led to depletion of natural resources, in particular of marine resources, which in a number of cases are beyond the levels of sustainability. The increasing population and the fact that most of Indonesians live close to the coasts or in coastal watersheds, combined with the depletion of natural resources, have led to increased levels of poverty in communities in the coastal areas. The increased pressure and the need to obtain revenue for subsistence have led to the proliferation of illegal fishing practices such as dynamite fishing or fish poisoning and to an overexploitation or destruction of ecosystems such as the mangrove forests which are crucial for coastal resources natural biological cycles and coastal protection.

The degradation of these vital habitats has undoubtedly been responsible for reductions in yields of marine fisheries in Indonesia. Declines in Coastal fishery production, close to the coasts they live, possibly resulting from the destruction of mangroves, coral reefs and associated habitats, has led to fishermen travelling farther distances to offshore fishing ground, which in turn the fishermen's income becomes lower due to high operational/exploitation costs and decreasing marine and coastal fishery resources. The larger part of the fishermen, approximately 75%, live below the poverty line. Coastal disaster is also exacerbated by poverty.

Therefore, there is need to make an investment in income generating activities to increase the incomes of the coastal communities through coastal community empowerment activities.

The activities of coastal community empowerment which had been executing through some programs which consists of: providing access to the capital utilize and technology. The implementation of capital access programs were executing through the development of micro finance institution or cooperation and these programs also provide the community escorts which held by the professionals. Furthermore, in order to recover social-cultural and normalize the rhythm of people lives, the MMAF through Directorate General of Marine, Coasts and Small Islands had executing the program to support the revitalization of local community institution as well as an indigenous knowledge.

In order to keep those activities stay on in right track and to ensure the expected result so that in term of program executing there are some approaching method that could be utilized, such as:

1. Community participation deal with planning, executing and inspection in sustainable development.
2. Community partnership, private sector and government to develop the activities that had been planned.
3. Community self help in development process

Those programs had also included disaster mitigation based on cultural knowledge. Local community in Simeuleu Island has a traditional system to anticipate the tsunami disaster as mentioned in point 3.3.1.

Hopefully, by the coastal community empowerment programs in tsunami affected areas, those people particularly the fishermen and fish farmer could persistence their socio-economic activities, grow as an attentive people due to disaster and expectantly for further goals, these programs could create sovereign and modern community.

3.5 Establishment of Indonesia Tsunami Early Warning System

Early warning saves lives. That's a very obvious lesson from the tsunami event. Early warning systems are considered the foundation of disaster mitigation. With the advances in science and technology, accurate forecasting of the occurrence of a natural hazard has saved thousands of lives and protected properties. It is very unfortunate indeed that the Indian Ocean lacks a tsunami warning systems just like the one installed in the Pacific. World leaders, who gathered in Jakarta on 6 January 2005 all agreed that a tsunami warning system should be established in the Indian Ocean as quickly as possible.

Indonesia is prepared and committed to develop and manage National Tsunami Early Warning System (TEWS) as a part of the Regional Indian Ocean TEWS. Indonesia has designed Grand Scenario of Indonesian TEWS that would be used for the establishing an effective and durable Indonesian TEWS on national scale which could provide the a tsunami warning in less than 5 minutes wherever the earthquakes occur in the Indonesian Region.

- a. Sthrengten the Indonesian TEWS to function as a regional TEWS for Indian Ocean.
- b. Increasing Public awareness and preparedness in the disaster afected region.
- c. Encourage and facilitated the capacity building of national research institutions in disaster mitigation.

The basic design of the Indonesian TEWS is as follows :

- a. Issue warning within 5 minutes.
- b. Real time, automatic, compatible with national and international standard.
- c. The component are : obsevation and integration data; dissemination of information; and community preparedness.
- d. Consists of 1 national disaster center and 10 Indonesian regional center.

3.6 Diasater management National Law

The Sumatera 2004 earthquake and tsunami were the rude awakening to a long sleep of Indonesian disaster management system. They shook us to the realisation of how exposed we are to various disasters. They demonstrated for us how vulnerable Indonesia is to impact of disasters, and that our capacity is simply to low to meet such ever increasing challenges. One of which is the absence of disaster management basic law.

It is true that the law alone would not prevent tsunami from devastating our shores, that the law alone would not prevent deaths, and that the law alone would not halt damages due to tsunami, the law would – however - provide the legal foundation and legitimacy for our government to undertake the necessary steps to reduce the risk of disasters, and thus to extend better protection to its people.

The outline of the Disaster Management Bill, as follow:

In term of paradigm :

1. Shifting from emergency response to disaster risk reduction. As such, the law will make disaster management to be undertaken throughout its cycle and to be made relevant to all aspects of our lives, not only during disaster emergency.
2. Shifting of protection as privilege of a few to protection as human right. Government has the constitutional duty to protect the nation and its people. As such, protection should no longer be privileges granted to those who can afford, rather it is a right of the people that government is dutybound to meet.
3. Shifting disaster management from government's business to the business of all. In this regard, disaster management to be part of everybody's business. It is a business of every individual, every family, every local government, organizations, UN agencies, regional organizations and central government.

Implication of such paradigm shifts, the disaster management bills would require among others: a) to enforce regular hazards identification, assessment, and monitoring; b) to mitigate the hazard of disasters; c) to ensure the preparedness of community and emergency responders; d) to make the necessary arrangements to enable surge capacity of emergency response both nationally and internationally; and e) to take reconstruction and rehabilitation as inseparable part of the disaster management.

In term of mechanisms, the Bill determines, among other, to require all government sectors to set aside certain portion of their revenues as resources to undertake disaster risk reduction measures and standby arrangements for emergency response. It empowers the government to declare disaster event as local, provincial or national disasters and, as such, outlines the authorities, asset control, and coordination that go with it. The Bill also provides the interfacing with regional and international communities in collaborative and surge capacities for emergency response.

With regard to enforcement, the Bill set sanctions for violation of its regulations, it imposes penalties and punishments for faults by omission and by commissions, and it even enable people to file lawsuits against government and other entities in relation to protection and disaster risk matters.

The Academic Draft and Draft Bill were presented to the House's Plenary and, the House established a Special Commission to bring the draft bill into the political processes. It has been resolved that the Bill will be approved by the House, to be, referred to the Executive Branch, and to be signed off before the end of the year 2005.

Clearly, this legislative measure will be a new beginning for Indonesia. It will bring the Indonesian people and nation closer to its constitutional ideals, and inches towards the fuller realization of human rights. The road ahead for this draft bill is arduous and perilous.

4. ACKNOWLEDGEMENT

The authors would like to acknowledge Prof. Paul Grundy from Monash University Australia for funding a travel and accommodation cost during his stay in Australia for attending the International Symposium on Disaster Reduction on Coasts, 14-16 November 2005 at Clayton Campus on Monash University, Australia.

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