DATA COLLECTION SURVEY
ON
ASEAN REGIONAL COLLABORATION
IN
DISASTER MANAGEMENT

FINAL REPORT

MAIN REPORT

DECEMBER 2012

JAPAN INTERNATIONAL COOPERATION AGENCY

NIPPON KOEI CO., LTD.
ALMEC CORPORATION
MITSUBISHI RESEARCH INSTITUTE, INC.

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EXECUTIVE SUMMARY

The JICA Study Team visited ten ASEAN member states and met officers of relevant organizations to collect information on disaster management. The JICA Study Team also conducted site reconnaissance where necessary, supplemented survey data with information through web-sites. The results of the data collection survey are summarized as follows.

1 Natural Disaster Profile of ASEAN Region

1.1 Background of Natural Disasters in the ASEAN Region

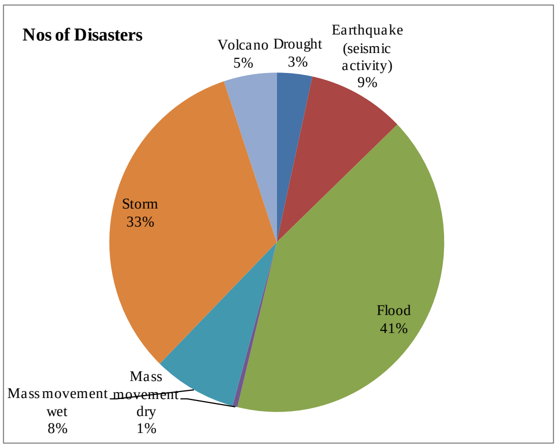
The ASEAN region, geographically located in southeast Asia, belongs to tropical climate zone except the northern parts of Lao PDR, Myanmar and Vietnam that belongs to temperate climate zone. The region receives plentiful precipitation in general, while precipitation decreases to extremely lower levels in regions where dry and wet seasons are apparent. In addition, typhoons or cyclones develop in the area of the Pacific off the Philippines or Bengal Bay, respectively. Such climate background is a cause of natural disasters such as floods, storms and drought in the ASEAN region.

From a geological point of view, the ASEAN region is composed of three tectonic plates, i.e., the Eurasia Plate, Philippine Ocean Plate and Australia Plate. Collision of these tectonic plates causes earthquakes/tsunamis and volcano eruptions. Further, the volcanic geology susceptible to erosion together with plentiful rainfall causes sediment disasters in Indonesia and Philippines where volcanoes are present.

All these natural conditions provide the background of natural disasters that have struck the ASEAN region.

1.2 Outline of Natural Disasters in the ASEAN Region

This sub-chapter describes an outline of natural disaster in ASEAN region based on the database EM-DAT [1] operated and maintained by CRED. The data used are for 32 years, i.e., from 1980 to 2011.



Data Source: EM-DAT; Presentation: JICA Study Team

Figure 1 Number of Natural Disasters (1980-2011)

The Number of Natural Disasters

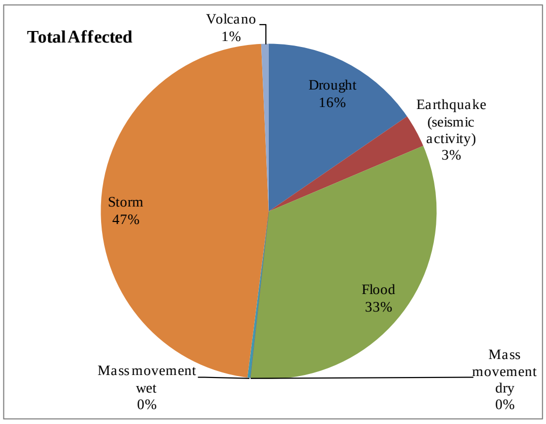
The number of natural disasters that occurred in the ten ASEAN countries during the 32-year period is 1,056. Among these, 74%

[1] "EM-DAT: The OFDA/CRED International Disaster Database: www.emdat.be - Université Catholique de Louvain - Brussels – Belgium

of natural disasters were floods and storms. Floods and storms are the homeostatic disasters in the region. Following these two disasters, earthquake[2] and sediment disasters (9% each) are frequent disasters, although these are not so frequent as floods and storms (Figure 1).

The Number of Total Affected People

The total affected people had reached 330 million (excluding deaths). In proportion to the number of disasters, storms (33%) and floods (47%) total to 80%. These two disasters are the ones that affect many people. Drought (16%) comes after storm and flood; these three disaster types totaling to 96% are climate-related disasters that are the most influential natural disasters in the ASEAN region (Figure 2).

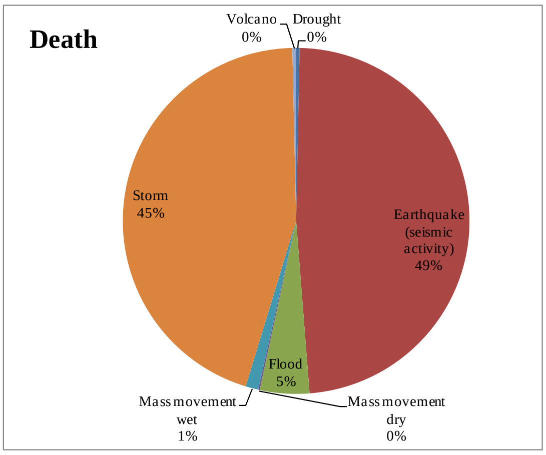


Data source: EM-DAT; presentation: JICA Study Team

Figure 2 Total Number of Affected People（1980-2011）

The Number of Death

A total death of 393,200 people is recorded in the database. Contrary to the number of the disasters and the total affected people, death due to earthquake (49%) is the largest in number, followed by the death due to storm (Figure 3). This is due to the reason that the Sumatra Island Earthquake in 2004 caused approximately 174,000 deaths and missing in the ASEAN region and the Cyclone Narigis sacrificed approximately 138,000 deaths and missing. These two disasters caused 70% of the total deaths from natural disasters in the years from 1980 to 2011. Earthquake and storm will have vast and fatal impacts on human lives once they strike.

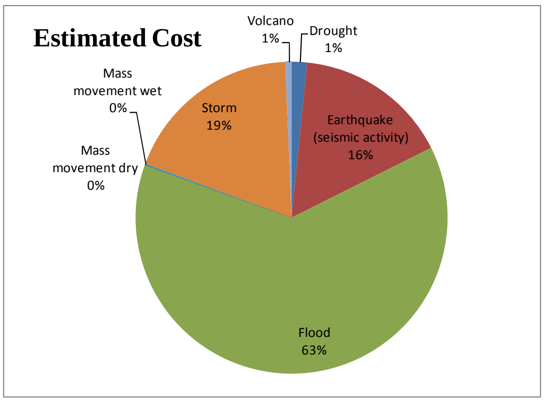


Data source: EM-DAT; presentation: JICA Study Team

Figure 3 Number of Deaths（1980-2011）

Estimated Cost

Total estimated cost in 1980 – 2011 due to natural disaster in ASEAN Region had reached 85,612 million US$. Among those, flood come the largest of 63%, followed by storm (19%) and earthquake (16%), the number of deaths of these two disasters is the largest. It is noted that about 53% (USD



Data source: EM-DAT; presentation: JICA Study Team

Figure 4 Estimated Cost（1980-2011）

[2] 'Earthquake' in EM-DAT is understood to include tsunami.

45,700 million) of the total estimated disaster cost was due to the flood that struck Thailand in 2011. This event suggests that natural disasters that strike industrial areas and/or large cities will seriously cause huge damage on the economy.

2 Inventory Survey on Disaster Management

Itemization of Inventory

JICA's Head Office has prepared the inventory on disaster management of relevant countries. The Study Team updated the inventories of the ten ASEAN countries with information that the Team collected during the survey conducted. In updating the inventory, the Team framed the inventory in such a manner that output items of AADMER Work Program 2010-2015[3] and the five priorities for action of the Hyogo Framework for Action 2005-2015 (HFA) are correlated for convenience to the disaster management-related people of ASEAN countries. The AADMER Work Program 2005 – 2015 is the guideline of the ASEAN member countries for disaster management.

Users will understand the progress of disaster management in their own country; thereby they may be able to make a plan for enhancement of disaster resilience. The ASEAN countries may refer to the inventories of other neighboring countries in order to promote collaboration in the field of disaster management. Similarly, donor agencies may be able to pick up issues from the inventories to initiate not only bi-lateral cooperation but regional cooperation as well.

On the other hand, users should note limitations of the inventories because these were prepared through interview survey with limited number of officers, reconnaissance survey of limited locations and other activities within a limited time of period.

It is therefore recommended for each country to update the inventory bi-annually.

It is also recommended that the information of the inventories should be uploaded in a database of the AHA Centre for information sharing among the ASEAN countries, to promote further collaboration in disaster management.

3 Issues and Needs of ASEAN Member Countries

Issues and needs based on the survey are summarized as follows.

3.1 Institutions and Organizations

Disaster Management Law

In keeping with the strategic goals of HFA, ASEAN countries have shifted their disaster management policy focus from responsive to preventive and mitigating orientation. As such policy shift is still in transition, not all ASEAN countries have established its institutional foundation in terms of legal and organizational arrangements.

[3] "ASEAN AGREEMENT DISASTER MANAGEMENT AND EMERGENCY RESPONSE Work Programme for 2010 -2015 "

Disaster management law is fundamental especially for disaster preventive/mitigating activities to be conducted efficiently as the government budget allocation for disaster management is attributed to its legal basis. An integrated budget for comprehensive disaster prevention and mitigating activities is scarcely prepared.

Disaster Management Organization at National Level

All ASEAN countries have disaster management organizations. Most of these organizations are composed of committees presided by a high-level government authority and the secretariat agencies, which are most likely under the leading ministry for disaster management. These committees are organized mainly for emergency response, and the secretariat agencies are expected to deal with disaster prevention, mitigation and preparedness apart from emergency arrangements without enough resources and authority in most cases.

Disaster Management Organization at Local Level

Disaster management organizations are also set up locally in most of the ASEAN countries.

Local disaster management organizations are expected to prepare the local disaster management plans, which extend their functions to mitigation and prevention activities. Local disaster management organizations are also involved in the community-based disaster management activities with assistance from external donors in most cases. Generally, community-based disaster management does not seem to be comprehensive, as its activities are partial and often ad hoc by donor supports. To make it sustainable, the institutional foundation at the local level needs to be strengthened by enhancing the capacity of local government organizations for disaster management.

Issues and Needs

The present institutional conditions of disaster management in ASEAN countries are summarized in Table 1 below.

Table 1 Institutional Conditions of Disaster Management in ASEAN Countries

<table>
<tr><th colspan="3">Institutional Conditions</th><th>Brunei</th><th>Cambodia</th><th>Indonesia</th><th>Lao PDR</th><th>Malaysia</th><th>Myanmar</th><th>Philippines</th><th>Singapore</th><th>Thailand</th><th>Vietnam</th></tr>
<tr><td rowspan="2">Disaster Management Law</td><td colspan="2">Presence</td><td>O</td><td rowspan="2"><2013></td><td>O</td><td rowspan="2"><2013></td><td rowspan="2">-[*2]</td><td rowspan="2"><2012></td><td>O</td><td rowspan="2">-[*3]</td><td>O</td><td rowspan="2"><2013></td></tr>
<tr><td colspan="2">Enacted <Planned> Year</td><td>2006[*1]</td><td>2007</td><td>2010</td><td>2007</td></tr>
<tr><td rowspan="2">Disaster Management Plan</td><td colspan="2">Presence at National Level</td><td>O[*4]</td><td>O[*5]</td><td>O</td><td>-[*6]</td><td>-[*7]</td><td>O</td><td>O</td><td>O[*8]</td><td>O</td><td>O[*9]</td></tr>
<tr><td colspan="2">Presence at Local Level</td><td>O</td><td>O</td><td>O</td><td>O[*10]</td><td>O[*11]</td><td>.</td><td>O</td><td>-[*12]</td><td>O</td><td>O</td></tr>
<tr><td rowspan="3">Disaster Management Organization</td><td rowspan="2">National Level</td><td>Committee</td><td>O</td><td>O</td><td rowspan="2">O[*13]</td><td>O</td><td>O</td><td>O</td><td>O</td><td>O</td><td>O</td><td>O</td></tr>
<tr><td>Secretariat</td><td>O[*14]</td><td>O</td><td>O</td><td>O</td><td>O</td><td>O</td><td>O</td><td>O</td><td>O</td></tr>
<tr><td colspan="2">Local Level</td><td>O</td><td>O</td><td>O</td><td>O</td><td>O</td><td>O</td><td>O</td><td>-[*15]</td><td>-[*16]</td><td>O</td></tr>
<tr><td colspan="3">Community-based Disaster Management</td><td>O</td><td>-[*17]</td><td>-[*17]</td><td>-[*17]</td><td>-[*17]</td><td>-[*17]</td><td>-[*17]</td><td>O</td><td>-[*17]</td><td>-[*17]</td></tr>
</table>

Source: JICA Study Team

Note: ‘O’: Available; ‘-’: Not Available

1*: Disaster Management Order subrogates the law; 2*: Malaysia needs more steps to start preparing a disaster management law; 3*: It seems unnecessary for Singapore to have a comprehensive disaster management law aside from other related laws because it is relatively free from natural hazards; *4: It consists of SNAP and SOP; *5: Implementation issue exists; *6: It will be approved within 2012; *7: SOPs subrogate it, having the plan is considered unnecessary; *8: Emergency plan subrogates it; *9: The plan is to be revised; *10: Five out of 16 provinces prepare it; *11: It will be revised; *12: It seems not necessary; *13: Committee is within the implementing organization; *14: It is still an interim arrangement; *15: It seems not necessary; *16: Local administrations provide the function of it; *17: Implemented mainly through donor-led programs.

According to information in the Table 1, the Study Team identifies and summarizes the issues and needs for cooperation as shown in Table 2. The JICA Study Team considers that the cooperation will be provided bilaterally between Japan and the respective ASEAN country or will be regionally provided among ASEAN countries as shown in Table 3.

Table 2 Issues and Needs on Institution/organization

Issues and Needs	Country									
	Brunei	Cambodia	Indonesia	Lao PDR	Malaysia	Myanmar	Philippines	Singapore	Thailand	Vietnam
1. Improvement of legal system for disaster management	-	O	-	O	O	O	-	-	-	O
2. Building intelligence infrastructure for planning of disaster prevention as well as mitigation measures	-	O	-	O	O	O	-	-	-	O
3. Formulation or updating of national disaster management plan	-	O	-	O	-	O	-	-	-	-
4. Local disaster management plan and implementation of community-based disaster management	-	O	-	O	O	O	O	-	O	O
5. Organizational and functional strengthening (shifting from response to prevention & mitigation) of disaster management institutions	-	O	-	O	-	O	-	-	-	O

Source: JICA Study Team

Legend: ‘O’: Issues/Needs identified; ‘-’: Issues/Needs not particularly identified

Table 3 Issues and Needs for Institutional Improvement of ASEAN Countries

Issues and Needs	Countries	Bilateral/ ASEAN Regional Cooperation
Improvement of legal system for disaster management	Cambodia Lao PDR Malaysia Myanmar Vietnam	(1) Bilateral cooperation International survey for information collection to standardize disaster management law for preparation, modification and enforcement. (2) ASEAN cooperation Standardization of ASEAN disaster management institutional arrangement. (Lead countries: Indonesia and Thailand)
Building intelligence infrastructure for planning of disaster prevention as well as mitigation measures	Cambodia Lao PDR Malaysia Myanmar Vietnam	(1) Bilateral cooperation Information collection on disaster management plans and its frameworks for replication referring to Japan's plan and framework as a basic case. Mitigation measures for every disaster are also collected for reference. (2) ASEAN cooperation Sharing basic information of disaster management plans and mitigation measures with each other in comparative manner for creation of a regional knowledge base.
Formulation or updating of national disaster management plan	Cambodia Lao PDR Myanmar	(1) Bilateral cooperation Using the frameworks of national disaster management plan of Japan, comprehensive framework is clarified. (2) ASEAN cooperation Standardization and modelling of national disaster management plan extracting good practices of ASEAN countries for replication and mutual learning.
Local disaster management plan and implementation of community-based disaster management	Cambodia Lao PDR Malaysia Myanmar Philippines Thailand Vietnam	(1) Bilateral cooperation Using the framework of the local level disaster management plan of Japan, a comprehensive framework is clarified for local level planning (community-based disaster management component is also included). (2) ASEAN cooperation Standardization and modelling of local disaster management plan as well as community-based disaster management practices extracted from ASEAN countries for replication and mutual learning.
Organizational and functional strengthening (shifting from response to prevention & mitigation) of disaster management institutions	Cambodia Lao PDR Myanmar Vietnam	(1) Bilateral cooperation Optimization of disaster management organizations including law revision. Support capacity development of professional staffs in the area of disaster management. (2) ASEAN cooperation Standardization of disaster management organizational structures and functions referring to the cases of advanced ASEAN countries (e.g., Indonesia and Thailand) and support latecomers.

Source: JICA Study Team

3.2 Issues and Needs Identified

(1) Flood/Storm

1) Present Conditions

Flood and storm are the most frequent disasters in the ASEAN region, causing enormous number of affected or dead people and huge amount of economic losses as previously described.

The typhoon Ketsana (named as Ondoy in the Philippines) caused extensive flood damages to the Philippines, Vietnam, Cambodia, Laos and Thailand in 2009. Besides, the combination of the tropical storm Haima and the typhoon Nock-ten caused extensive damages to Myanmar, Thailand, Laos and Cambodia in 2011. These severe flood events have clarified major issues regarding flood damages of recent years in the ASEAN countries.

Efforts have been made to prepare hazard maps by ASEAN member countries as shown in the Table 4. However, most of maps are of scales that are to be used for policy decisions; those of detailed scales have yet to be prepared. These maps are to be used at community level for preparedness and emergency response, or to be used for detailed damage analysis for insurance purposes.

Table 4 Summary of Preparation of Flood Hazard Maps

Country / *Region*	Preparation of Flood Hazard Map			
	Status	Covered Area	Map Scale	Information Source
Brunei	Completed	Whole country	To be confirmed	Interview
Cambodia	In preparation	Whole country	Large scale; usable only for policy decision	Interview
Indonesia	Completed (large scale map)	Whole country	Each province level	BMKG's website
Lao PDR	Partially completed	8 Flood-prone areas	1:90,000 – 1:550,000	ADPC's report
Malaysia	Partially completed	15 Flood-prone areas	To be confirmed	DID's PPT
Myanmar	In preparation	Bago region	To be confirmed	Interview
Philippines	Partially completed	22 provinces	To be confirmed	Interview
Singapore	Completed	Whole country	1:36,000	PUB's website
Thailand	Partially completed	Whole country	To be confirmed	Govt.'s PPT
Vietnam	Partially completed	4 provinces	To be confirmed	Interview
Mekong Basin	*Completed*	*Middle to lower reaches*	*1:400,000*	*MRC's website*

Source: JICA Study Team
Note: The above summary does not totally represent all the information provided.

Considering all aspects, the Team surveyed the common issues and needs on flood disasters for ASEAN countries are summarized as the Table 5 below:

Table 5 Issues and Needs on Flood Disasters

Issues and Needs on Flood Disasters	Country									
	Brunei	Cambodia	Indonesia	Lao PDR	Malaysia	Myanmar	Philippines	Singapore	Thailand	Vietnam
Flood early warning and integrated planning against wide range of floods caused by typhoons and cyclones	-	O[#1]	-	O[#2]	-	O[#3]	O[#4]	-	O[#5]	O[#6]
Flood early warning and integrated planning against flash floods occurred in mountainous area, urban areas and semi-arid lands	O[#7]	O[#8]	-	O[#9]	O[#10]	O[#11]	O[#12]	-	O[#13]	O[#14]
Flood control and drainage planning for urban areas and SEZ (Securing safety degree against floods in urban areas, SEZ and supply chains)	-	O[#15]	P[#16]	P[#17]	P[#18]	P[#19]	-	P[#20]	O[#21]	O[#22]
Flood control planning in economic corridors including roads and ports (Securing safety degree against floods in supply chains)	-	O[#23]	-	P[#24]	P[#25]	P[#26]	-	-	O[#27]	-
Urban drainage planning associated with urban land subsidence, storm surges and rising of sea level	-	-	O[*1]	-	-	-	-	-	-	O[*2]
Flood risk assessment survey for the purposes of investment risk assessment and flood insurance (including development of flood hazard maps)	-	O[#28]	O[#29]	O[#30]	O[#31]	O[#32]	-	-	O[#33]	O[#34]
Improvement of legal frameworks for the enactment of reservoir operation rule (improvement of legal systems in order to prevent artificial flood disasters caused by inappropriate reservoir operation of PFI hydropower dams)	-	O[#35]	-	O[#36]	-	O[#37]	O[#38]	-	O[#39]	O[#40]

Source: JICA Study Team

Legend: 'O' = considered to be necessary; 'P' = considered to be potentially necessary;
'-'= Information was not made available to consider

Note 1: Regarding urban drainage planning associated with urban land subsidence, storm surges and rising of sea level, the above table shows only areas that were raised in the interview with JICA Study Team (*1*2).

Note 2: *1 Indonesia (DKI Jakarta); *2 Vietnam (Ho Chi Ming, Mekong Delta area)

Note 3: #1#8: refer to 7.1.2 (1)(3)(6); #2#9: refer to 7.1.4 (1)(3)(6); #3#11: refer to 7.1.6 (1)(3); #4#12: refer to 7.1.7 (1)(3); #5#13: refer to 7.1.9 (1)(3)(4); #6#14: refer to 7.1.10 (1)(3)(6); #7: refer to 7.1.1 (1); #10: refer to 7.1.5 (1) especially for urban areas; #15: refer to 7.1.2 (7)-(b); #16#17#18#19#20#24#25#26: regarded as 'potential' because detail information were not obtainable although some related issues were raised in the interview with JICA Study Team; #21#27: refer to 7.1.9 (1)(4); #22: refer to 7.1.10 (6); #23: refer to 7.1.2 (7)-(c); #28#29#30#31#32#33#34: regarded as 'necessary' in order to formulate flood control plans for SEZs and/or economic corridors with an exception of Singapore that has already assessed flood risk; #35: refer to 7.1.2 (7)-(d); #36: refer to 7.1.4 (7)-(a); #37: refer to 7.1.6 (4); #38: refer to 7.1.7 (6); #39: According to the Foundation of National Disaster Warning Council (FNDWC), at the time of 2011 floods, too much water have been kept in the upstream dams at the end of rainy season and they have to release a large amount of water at the same time, which has caused floods. This means that floods did not occur due to wrong operation, but it is because dam operation rules in consideration of flood control has not been legally determined; #40: refer to 7.1.10 (6)

2) Proposed Aid Projects for Flood Disasters in each ASEAN Country

To solve the above-mentioned issues, it is proposed to implement the following aid projects in each ASEAN country (Table 6):

Table 6 List of Proposed Aid Projects for Flood Disasters in each ASEAN Country

Country	List of Projects
Brunei Darussalam	Although the country suffers from flash floods, countermeasures are possible to be implemented through the country's own fund.
Cambodia	(i) Formulation of Strategic Flood Control Plan in the Kingdom of Cambodia (ii) Master Plan Study on Integrated Flood Management in the Siem Reap River Basin (iii) Review of Master Plan for Urban Drainage in Phnom Penh (iv) Study on Flood Risk Assessment for SEZs in the Kingdom of Cambodia (v) Study on Improvement of Legal Systems for Enactment of Reservoir Operation Rules (vi) Capacity Development of MOWRAM for Flood Management
Indonesia	(i) Study on Flood and Earthquake Risk Assessment in Bukasi – Karawang Region (ii) Study on Flood and Earthquake Risk Assessment for Economic Corridors Including Tanjung Priok Port, New Kalibau Container Terminal and Planned New Airports
Lao PDR	(i) Formulation of Strategic Flood Control Plan in Lao People's Democratic Republic (ii) Master Plan Study on Urban Drainage in Vientiane (iii) Study on Flood Risk Assessment for SEZs in Lao People's Democratic Republic (iv) Study on Improvement of Legal Systems for Enactment of Reservoir Operation Rules
Malaysia	(i) Study on Flood Risk Assessment for the Economic Corridor Johor – Kuala Lumpur – Penan – Kuda
Myanmar	(i) Master Plan Study on Integrated Flood Management in the Sittang River and the Bago River basins (ii) Study on Flood Risk Assessment for the Thirawa SEZ (iii) Master Plan Study on Urban Drainage in Yangon
Philippines	(i) Technical assistance for development of flood hazard map and flood risk assessment depending on the intended use (ii) Study on Improvement of Legal Systems for Enactment of Reservoir Operation Rules
Singapore	Urban drainage measures for Orchard Road (commercial accumulation zone): Although it is possible to procure countermeasures by the country's own fund, the issue has not been solved. There is an option that the private sector provides technical assistances for underground drainage tunnel, underground reservoir, pumping facilities, etc, which have been implemented in Tokyo.
Thailand	(i) Urgent Study on the Improvement of Legal Systems for Restructuring of Flood Reinsurance
Vietnam	(i) Master Plan Study on Urban Drainage in Hanoi (ii) Study on Flood Risk Assessment for the West Hanoi SEZ (iii) Master Plan Study on Urban Drainage in Ho Chi Minh (iv) Formulation of Strategic Flood Control Plan in Can Tho

Source: JICA Study Team

3) Proposed Projects for Flood Disaster for ASEAN Collaboration

The following projects are expected to be more effective if they are implemented through ASEAN collaboration:

- Preparation of guideline on improvement of legal systems for enactment of reservoir operation rules
- Preparation of guideline on flood risk assessment

(2) Earthquake/ Tsunami

1) Present Conditions

Although the frequency of earthquake/tsunami is not higher than storm and flood, an earthquake/tsunami disaster causes considerable huge losses of not only human lives but also the economy (Figures 1, 3 and 4). In particular, tsunami disaster is one of such disasters that are difficult to prevent physically. Thus, the Team considers that monitoring and early warning will be of paramount importance for people to evacuate.

Table 7 below shows the present situation of monitoring and early warning in ASEAN countries.

Table 7 Present Situation of Monitoring and Early Warning in the ASEAN Region

Country		Broadband Seismograph	Accelero-graph	GPS	Tsunami		EWS for Tsunami	Warning System
					Buoy	Gage		
Earthquake Countries	Indonesia	160	216	20	23 (2 Operational)	58	BMKG (InaTEWS)	24 sirens
	Myanmar	12 (5 operational)	11	0	0	2	Nil	Nil
	Philippines	66	6	2	1 (wet sensor)[*1]	47	PHIVOLCS	Each barangay
	Thailand	41	22	5	3 (all damaged)	9	NDWC	328 Warning tower
Surrounding Countries	Brunei	*tbc*	*tbc*	*tbc*	*tbc*	Installed	Nil	Nil
	Cambodia	*nil*	*nil*	*nil*	*nil*	*nil*	*nil*	*nil*
	Lao PDR	2	2	9	-	-	-	-
	Malaysia	17	13	191	3	17	MMD (MNTEWC)	23 sirens
	Singapore	2	6	*tbc*	0	12	MSS (TEWS)	Installed
	Vietnam	15	*tbc*	*tbc*	*tbc*	2	IoG	10 Sirens
Japan (March 2012)		*142 (HSS[*2]=1,270)*	*3,559[*3] 724[*4]*	*1,494*	*Tidal gauge + tsunami gauge=247[*5]*		*JMA, others*	*Sirens/ TV /Radio /others*

Source: All the information of ASEAN countries were collected by JICA Study Team (2012); Information of Japan were from HP of Headquarters for Earthquake Research Promotion;
Note : *tbc*: to be confirmed; [*1] WET sensor: tsunami-detecting sensor installed at coast lands; [*2]: HSS: High sensitivity seismograph; [*3]: Surface type, there are about 2,900 other points; [*4]: Underground type; [*5]:There are 15 GPS tidal gauges and 35 water pressure gauges at the bottom of the sea;

The density of monitoring instruments may differ from country to country depending on the policy it takes for disaster management. As for Japan, the plan[4] proposed the interval of monitoring devices at 15-20 km for height sensitivity monitoring seismograph, 100 km for broadband seismograph, 15-20 km for accelerograph and 20-25 km for GPS[4]. As a result, considerably dense monitoring networks have been establised as shown in the Table 7.

As an earthquake-prone country, Indonesia has made its efforts to establish a monitoring and early warning network planned for InaTEWS. The SATREPS, collaborative researches of Indonesia and Japanese researchers assisted in providing a technical assistance in line with

[4]"Fundamental Research and Monitoring Plan for Earthquake", August 1997, Headquarters for Earthquake Research Promotion, Japan (in Japanese)

practices of Japan. The Study Team considers that proper maintenance and necessary enhancement of InaTEWS will be of priority.

Similarly, the Philippines also has made its efforts to improve its REDAS – disaster estimation system developed by itself through the SATREPS that provided broadband seismometers and accelo-meters; while PHIVOLCS considers it more practical to install more wet sensors (tsunami sensors: one is presently operational as against 10 sensors planned) at remote islands to monitor tsunami. In any case, the Study Team considers it essential to enhance the earthquake/tsunami monitoring networks.

Thailand, where approximate 5,300 people were sacrificed in the Sumatra Island Earthquake in 2004 started to install monitoring facilities after the earthquake. A total of 41 broadband seismometers have been installed, resulting in a monitoring network with about 150 km interval except some areas; which has reached a similar level as the monitoring network of Japan. No urgent requirement has been identified in this regard.

Myanmar, where inland earthquake occurs, needs considerable amounts of accelo-meters and GPS. The Team considers it necessary to enhance the monitoring network by providing monitoring equipment and technical assistance for data analysis.

2) Earthquake Considered to Occur in the South China Sea and other Neighboring Seas

Recently, USGS pointed out that earthquakes will possibly occur at the Manila Trench off the Philippines in the South China Sea. The earthquake will cause tsunamis that will strike the coastal areas of Brunei, Indonesia, Malaysia, the Philippines and Vietnam, which face the South China Sea. Furthermore, at trenches in neighboring seas i.e. Sulu Sea and Celebes Sea between Indonesia and the Philippines, huge earthquakes and tsunamis are considered to occur. Officers responsible for disaster management pointed out that detailed research and disaster management plan will be urgently necessary.

3) Issues and Needs

Based on the survey, the Study Team considers issues and needs are as follows.

Table 8 List of Main Projects for Seismic and Tsunami Disaster Management

Country	Project
Countries for Detailed Survey	
Indonesia	1) Enhancement of the tsunami observation system for InaTEWS 2) Formulation of disaster management plan and BCP for Jakarta 3) Research on seismology and tsunami
Myanmar	1) Development of earthquake and tsunami observation network and capacity development for observation and analysis 2) Formulation of disaster management plan and BCP for main cities
Philippines	1) Enhancement of earthquake and tsunami monitoring networks 2) Integrated urban disaster management plan for Metropolitan Manila and surrounding areas 3) Earthquake damage estimation and integrated urban disaster management for large local cities such as Cebu and Davao
Thailand	1) Study on development for earthquake monitoring system and disaster prevention plan
Other Countries	
Brunei, Malaysia, Vietnam	1) Formulation of tsunami disaster management plan including disaster risk assessment, proposing tsunami monitoring and early warning systems 2) Regional collaborative research on the mechanism and characteristics of earthquake and tsunami induced by the Manila trench
Lao PDR	3) Development of earthquake observation network and capacity development for operation of observation network.
Singapore, Cambodia	No particular issues and needs were identified.

Source: JICA Study Team

(3) Volcano

1) Present Conditions

Although the frequency and number of total affected people of volcano disasters are not as high for all ASEAN countries, these are serious disasters in Indonesia and the Philippines where there are many active volcanos.

Merepi Volcano in Indonesia caused injuries of 110,000 and 151,745 and deaths of 10 and 23, respectively, when it erupted in 2006 and 2010. Mayon Volcano erupted in 2006 and 2009-2010, causing affected people of 43,949 and 141,161 people respectively. No deaths were reported, however, 1,143 were killed by lahar (debris flow of volcanic materials) caused by a heavy rain after the eruption in 2006.

The SATREPS–collaborative researches conducted through bilateral cooperation assisted these two countries in continuing improvement and enhancement of the existing volcanic monitoring network for the purpose of monitoring and early warning improvement.

The Study Team considers that the following assistance will be needed.

Table 9 List of Proposed Cooperation Projects for Volcanic Disaster

Country	Project
Indonesia	- Improvement/enhancement of the existing volcanic observation network
Philippines	- Expansion of volcanic observation systems

Source: JICA Study Team

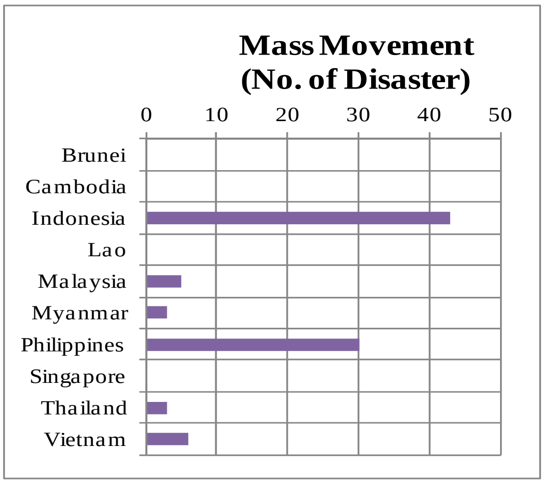
(4) Sediment Disasters

1) Present Conditions

The frequency of sediment disasters shows 9% (Figure-1) for all ASEAN countries, whereas the disasters occur mainly in Indonesia and the Philippines as shown in Figure 5. This is because the geology of both countries is composed of volcanic materials that are susceptible to erosions on top of prevailing heavy rains in tropical climate. As most of sediment disasters occur in mountainous areas where infrastructures and other facilities are not developed enough, economic losses are not large as compared to the number of disasters and deaths. On the other hand, sediment disasters cause 80% of deaths among total affected people, implying that disasters will cause fatal impacts on human lives once these should occur, as demonstrated in Figure 6.

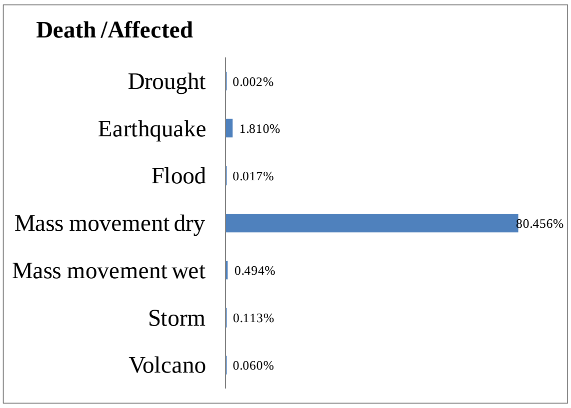
From this humanitarian point of view, the Team considers that comprehensive sediment disaster management plans are needed, in particular in Indonesia and the Philippines.

On the other hand, Lao PDR requested a study for sediment disaster management plan for a truck road.



Data：EM-DAT; Presentation: JICA Team

Figure 5 Number of Sediment Disasters in ASEAN Countries（1980-2011）



Data：EM-DAT; Presentation: JICA Team

Figure 6 Death/Total Affected People（1980-2011）

2) Issues and Needs

Based on the above results, the issues and needs which the Study Team considered are shown in the Table 10 and 11.

Table 10 Issues and Needs for Sediment Disasters

Issues and Needs	Country									
	Brunei	Cambodia	Indonesia	Lao PDR	Malaysia	Myanmar	Philippines	Singapore	Thailand	Vietnam
1. Development/improvement of sediment disaster hazard maps for countermeasure plan, land-use plan and evacuation plan	-	-	*	O	*	O	*	-	*	*
2. Development of monitoring and early warning system, including analysis technology	-	-	*	O	*	O	*	-	*	*
3. Introduction and upgrade of proactive structural measures for sediment disasters	-	-	O	O	*	O	O	-	O	O
4. Sediment disaster prevention planning in economic corridors to develop safe/secure transportation	-	-	O	O	-	O	*	-	O	O
5. CBDRM for sediment disasters	-	-	*	O	*	O	*	-	*	*

Source: JICA Study Team
Legend: ‘O’: Issues/Needs identified; ‘*’: Available at present, to be enhanced/improved; ‘-’: Issues/Needs not particularly relevant

Table 11 List of Draft Cooperation Projects for Sediment Disaster Management

Country	Project
Indonesia	- Study on comprehensive sediment disaster management plan in prioritized areas
Loa PDR	- Development of the road disaster prevention plan for the economic corridor and capacity development for road maintenance and management sector.
Malaysia	- Study on comprehensive sediment disaster management plan in Kundasang (Kota Kinabalu) of Sabah district, Uluk Klang of Selangor district, and Cameron Highlands of Pahang district
Myanmar	- The Study Team is considering a study on comprehensive sediment disaster management in mountainous areas, including CBDRM
Philippines	- Study on the comprehensive sediment disaster management plan
Thailand	- Study on development of sediment disaster monitoring and effective utilization of SABO technology
Vietnam	- A Study on Comprehensive Sediment Disaster Management in Vietnam.

Source: JICA Study Team

3.3 Knowledge, Innovation and Education

This sub-section corresponds to the priority for action of the HFA-3 that includes various categories of actions. Among those, the Team describes present conditions, issues and needs of computer-based disaster management system as it is considered as a fundamental requirement for effective disaster management.

Present Conditions of Disaster Management Information System

Effective disaster management will be realized with proper data collection mechanisms and systematic data storage (database) and smooth data processing.

The present conditions of availability of disaster management information system are summarized as follows.

Table 12 Present Situations of Disaster Information System and EWS

Information System on Disaster Management	Country									
	Brunei	Cambodia	Indonesia	Lao PDR	Malaysia	Myanmar	Philippines	Singapore	Thailand	Vietnam
Disaster Management Information System (computer-based)	*n/a*	*u/c*	O	*u/c*	O	*n/a*	O	O	*n/a*	*n/a*
Disaster Loss Database	*n/a*[*1]	*u/c*	O	*u/c*	*n/a*	*n/a*	O	*n/r*[*2]	*n/a*	O[*3]

Source: JICA Study Team (2012), National progress report on the implementation of the Hyogo Framework for Action (2007-2009, 2009-2011)
Note: *1: disaster losses are systematically reported, monitored and analyzed; *2: a disaster loss database for natural disaster is not needed because a large disaster has not occurred so far; *3: the database has information on main disasters since 1989, but CCFSC maintains records for much longer but only on hard-copies;
'O': available; '*n/a*': not available; "*u/c*": under construction; "*n/r*": not relevant; *d-n/a*: data not available; -p: pilot project only

Based on Table 12, the issues and needs that the JICA Study Team is considering are shown in Table 13 below. Table 13 includes not only bi-lateral cooperation but cooperation to the AHA Centre as all these should have linkage to their fundamental databases for effective collaboration in disaster management.

Table 13 Issues and Needs for Disaster Management Information System[5]

Issues and Needs	Country	Bilateral/ ASEAN Regional Cooperation
Development of Disaster Management Information System	Brunei Myanmar Philippines*a (Thailand)*b Vietnam	1. Bilateral cooperation - Development of disaster management information system based on GIS. 2. ASEAN cooperation - (proposed in the other section called "ADMIS")
Development of Disaster Loss Database	Brunei (Malaysia)*b Myanmar Vietnam	1. Bilateral cooperation - Establishment of a mechanism for collecting and accumulating disaster loss data. - Development of disaster loss database and sharing system. 2. ASEAN cooperation - Improvement of ASEAN DRR Portal and accumulating disaster loss data of each county. (Lead organization: ASEAN Secretariat and/or AHA Centre) - Development of disaster loss database and sharing system for ASEAN region. (Lead organization: AHA Centre)

Source: JICA Study Team

Note: *a: Available DMIS is not GIS basis; *b: The countries are considered to be capable to establish.

3.4 Dissemination of Early Warning information

Table 14 shows the present situation of dissemination of early warning information of ASEAN countries.

5 All the views are attributed to the JICA Study Team.

Most of the ASEAN countries, except one country, have established their mechanism for information dissemination among governmental agencies including local government for urgent warning. On the other hand, such mechanisms operate partially or in a limited extent in the four countries as indicated in the Table 14.

Table 14 Present Situation of Early Warning

<table>
<tr><th rowspan="2"></th><th colspan="2">Information Flow</th><th colspan="10">Country</th></tr>
<tr><th>From</th><th>To</th><th>Brunei</th><th>Cambodi</th><th>Indonesia</th><th>Lao PDR</th><th>Malaysia</th><th>Myanmar</th><th>Philippin</th><th>Singapore</th><th>Thailand</th><th>Vietnam</th></tr>
<tr><td rowspan="3">Means of warning dissemination (Availability of procedural guidelines, facilities/equipment, mechanism)</td><td>Monitoring Agency</td><td>Decision making agencies at national level and local level</td><td rowspan="2">O
a</td><td rowspan="2">u/c
a</td><td rowspan="2">O
a</td><td rowspan="2">O
a</td><td rowspan="2">O
a</td><td rowspan="2">tel
a</td><td rowspan="2">O
a</td><td rowspan="2">O
a</td><td rowspan="2">O
a</td><td rowspan="2">O
a</td></tr>
<tr><td>Decision making agency</td><td>Local government</td></tr>
<tr><td>Local government</td><td>Communities under impending hazard</td><td>*
a,b</td><td>*
a</td><td>O
b</td><td>*
a</td><td>O
a</td><td>*
a,b</td><td>O
b</td><td>O
a</td><td>O
a</td><td>*
a</td></tr>
</table>

Legend: O: Available for operation; *: Partially available/limited function; u/c: Under construction; tel: Public telephone line only

Sources: a: Interview by the Team, b: National progress report on the implementation of the Hyogo Framework for Action (2007-2009, 2009-2011)

Based on the information above, the JICA Study Team is considering the following issues and needs (Table 15).

Table 15 Needs for Early Warning

Country	Needs
Brunei[6], Cambodia[7], Lao PDR[8], Myanmar[9] Vietnam[10]	- Development of means of early warning (procedural guidelines and/or facilities/equipment, mechanism) , from governmental agencies to communities; - Implementation of CBDRM

Source: JICA Study Team

On the other hand, countries who have established dissemination tools and mechanisms generally have issues that public awareness is not sufficient and therefore, people do not evacuate even when they noted the early warning. This was experienced in Aceh, Indonesia in 2012, when a severe tremor hit that area. Promotion of CBDRM will be of paramount importance.

6 Interview survey to Tutong District Office (Brunei) by the JICA Study Team
7 Interview survey to NCDM (Cambodia) by the JICA Study Team
8 Proposed by the JICA Study Team based on the interview with MDMO (Lao PDR)
9 Proposed by the JICA Study Team based on the interview with MDPA (Myanmar))
10 Proposed by the JICA Study Team based on the interview with DDMFSC (Vietnam)

3.5 Emergency Response

Table 16 shows the present condition of emergency response from view points of planning, funding, operation/procedure and disaster drills.

Table 16 Preparedness for Emergency Response: Ten ASEAN Countries

Country	Contingency Plan	Funding	Operation/Procedure	Disaster Drill
Brunei	-	O	O (Waited for new SOP to be approved within 2012)	O (Conducted in 2/4 Districts)
Cambodia	Expected to be approved within 2012)	O	Expected to have a mechanism of implementation	Donor-led
Indonesia	O (20-30 Districts/ Cities have prepared)	O	O (Procedures are limited to national level)	O
Lao PDR	Expected to be revised, while it is still limited to flood	O (Not enough)	Expected to revise SOP & contingency plan	Donor-led
Malaysia	-	O	O (i.e., Seven SOPs)	O
Myanmar	O (Standing Order)	O (Not enough)	O (i.e., Standing Order)	O
Philippines	Expected to be prepared covering multiple hazards	O	Expected to prepare SOP	O (Coverage unknown)
Singapore	O	O	O	O
Thailand	Expected to formulate new one, reflecting the lessons from 2011 flood.	O	O	O
Vietnam	O (It is formulated every year up to commune level)	O (Not enough)	-	Model activity to be rolled out.

Source: JICA Study Team; Note: O: Available

Overview of the contingency plans across the ten ASEAN countries indicates the following needs.

a) Plans need to be extended to cope with multiple disasters[11]: Lao PDR, the Philippines, and Vietnam
b) Capacity development to gain expertise[12]: Cambodia, Lao PDR, Myanmar, and the Philippines.

As for the operation/ procedure for emergency response, certain needs are observed as follows.

a) Establishment of operation mechanism[13]: Cambodia, Lao PDR and the Philippines
b) Preparation of SOP[14]: Lao PDR, the Philippines and Vietnam

4 Identified Projects for ASEAN Regional Collaborations

The Study Team has identified the needs of projects for ASEAN regional collaboration as shown in the Table 17.

[11] The need is identified by the JICA Study Team, while the Philippines identified by itself.
[12] The need is identified by the JICA Study Team.
[13] The need is identified by the JICA Study Team.
[14] The need is identified by Lao PDR and the Philippines, while JICA Study Team identified it for Vietnam.

Table 17 Identified Disaster Management-related Projects for ASEAN Regional Collaboration

Project	Target	Purpose	Task	Mode of Cooperation
1. Study on Comprehensive Disaster Management Plan for Mega Cities in ASEAN Region	Jakarta, Yangon, Manila, Bangkok, other mega cities where multi-disasters may strike	- To minimize damages by multi-disasters in mega-cities of ASEAN region	- To conduct natural disaster risk assessment - To formulate comprehensive disaster management plan	- Technical cooperation/ collaborative researches among ASEAN countries (regional collaboration) - Technical assistance to target mega cities (bi-lateral cooperation)
2. Establishment of Satellite Imagery Analysis Technology Center	AHA Centre ASEAN countries	- To collect near real time disaster information through analyzing updated satellite information by the AHA Centre	- To provide tools for satellite information analysis - To transfer analysis technology - （Concept for the future) to establish the ASEAN branch of Sentinel Asia	- Technical cooperation to AHA Centre (ASEAN Regional Cooperation)
3. Study on Natural Disaster Risk Assessment and BCP Formulation for Industrial Clusters in the ASEAN Region	Industrial clusters in ASEAN region	- To minimize loss of functions and to maximize resilience of industrial clusters in the ASEAN region in case of disasters	- To conduct natural disaster risk assessment - To formulate BCP for the industry clusters	- Technical cooperation /collaborative research (regional collaboration) - Technical cooperation to target industrial clusters (bi-lateral cooperation)
4. Study on Comprehensive Disaster Management for Earthquake/Tsunami in South China Sea and Neighboring Seas	Brunei, Indonesia, Malaysia Philippines, Vietnam (Earthquake/Tsunami in South China Sea, Sulu Sea and Celebes Sea)	- To minimize losses and damages of coastal areas of target countries, losses and damages by earthquake/tsunami	- To research mechanism of earthquake and tsunami in the seas - To conduct earthquake/tsunami risk assessment - To formulate disaster management plans for the target cities in the target countries	- Collaborative research among research institutes in the ASEAN region (ASEAN collaboration) - Technical assistance to target cities in the target countries (bi-lateral cooperation)
5. Study on Construction of ASEAN Disaster Management Information System（DMIS）	AHA Centre ASEAN counties	- To build a tool (DMIS) that will assist the AHA Centre in analyzing vulnerability, anticipating disaster occurrence, making disaster management plans, emergency response and others	- To collect comprehensive information in ASEAN countries - To build a database - To build DMIS	- Technical cooperation to AHA Centre (ASEAN Regional Cooperation)Data collections in ASEAN countries （bi-lateral cooperation）
6. Study on Construction of Disaster Management Information System in Major Cities of the ASEAN Region with ASEAN Common Data Format	ASEAN Countries AHA Centre	- To build DMIS for major cities of each ASEAN country to assist in the formulation of comprehensive disaster management plans of mega cities - To propose a common data format as ASEAN standard	- To collect comprehensive information in major cities of ASEAN countries - To build a database for each city - To build DMIS - To establish linkage with between ADMIS of AHA Centre	- Technical cooperation to target cities(bi-lateral cooperation) - Technical cooperation to AHA Centre (ASEAN Regional Cooperation)）

List of Abbreviations and Acronyms

A		
AADMER	:	ASEAN Agreement on Disaster Management and Emergency Response
AAL	:	Average Annual Loss
AASHTO	:	American Association of State Highway and Transportation Officials
ABaDRM	:	Aceh Barat Disaster Risk Map
ACDM	:	ASEAN Committee for Disaster Management
ADMIS	:	ASEAN Disaster Management Information System
ADPC	:	Asian Disaster Preparedness Center
ADRC	:	Asian Disaster Reduction Centre
ADRM	:	Aceh Disaster Risk Map
AED	:	Automated External Defibrillator
AEIC	:	ASEAN Earthquake Information Center
AHA Center	:	ASEAN Coordination Center for Humanitarian Assistance on Disaster Management
AIFDR	:	Australia-Indonesia Facility for Disaster Reduction
ANDMON	:	ASEAN Natural Disaster Monitoring Network
ARDEX	:	ASEAN Regional Disaster Emergency Response Simulation Exercise
ASEAN	:	Association of South East Asian Nations
ATaDRM	:	Aceh Tamiang Disaster Risk Map
AusAID	:	Australian Agency for International Development
B		
BAKORNAS PB	:	Badan Koordinasi Nasional Penanggulangan Bencana (National Coordinating Board for Disaster Management)
BAKOSURTANAL	:	Badan Koordinasi Survei dan Pemetaan Nasional (National Coordination Agency for Surveys and Mapping)
BBWS	:	Balai Besar Wilayah Sungai (River Basin Development Agency)
BCP	:	Business Continuity Plan
BDMS	:	Brunei Darussalam Meteorological Service
BDRRMC	:	Barangay Disaster Risk Reduction Management Council
BIG	:	Badan Informasi Geospasial (Geospatial Information Agency)
BMA	:	Bangkok Metropolitan Administration
BMA	:	Bangkok Metropolitan Area
BMKG	:	Badan Meteorologi, Klimatologi, dan Geofisika (Meteorological, Climatological and Geophysical Agency)
BNPB	:	National Agency for Disaster Management
BPBA	:	Badan Penanggulangan Bencana Aceh (Aceh Disaster Management Agency)
BPBD	:	Badan Penanggulangan Bencana Daerah (Regional Disaster Management Agency)
BPBK	:	Fire and Disaster Management Agency
BPPT	:	Badan Pengkajian dan Penerapan Teknologi (Agency for the Assessment and Application of Technology)
C		
CBDRM	:	Community-Based Disaster Risk Management
CCA	:	Climate Change Adaptation
CCDM	:	Commune Committee for Disaster Management

CCFSC	:	Central Committee for Flood and Storm Control
CCFSC&SR	:	Commune Committee for Flood and Storm Control & Search and Rescue
CCTV	:	Closed Circuit Television
CDMRC	:	Central Disaster Management and Relief Committee
CEA	:	China Earthquake Administration
CEPP	:	Community Emergency Preparedness Programme
CERT	:	Country emergency Rescue Team
CEWS	:	Climatological Early Warning System
COD	:	Chief of officer on duty
CPR	:	Cardio-Pulmonary Resuscitation
CRED	:	Center for Research on the Epidemiology of Disasters
CVGHM	:	Centre for Volcanology and Geological Hazard Mitigation
D		
DARD	:	Department of Agriculture and Rural Development
DART	:	Deep-ocean Assessment and Reporting of Tsunamis
DART	:	Disaster Assistance and Rescue Team
DCA	:	Department of Civil Aviation
DCC	:	Disaster Command Center
DCDM	:	District Committee for Disaster Management
DCFSC&SR	:	District Committee for Flood and Storm Control & Search and Rescue
DDMC	:	District Disaster Management Committee
DDMFSC	:	Department of Dyke Management, Flood and Storm Control
DDMRC	:	District Disaster Management and Relief Committee
DDPM	:	Department of Disaster Prevention and Mitigation
DEOC	:	District Emergency Operation Centers
DEPT	:	Department of Educational Planning and Training
DGM	:	Department of Geology and Mining
DGWR	:	Directorate General of Water Resources
DHRW	:	Department of Hydrology and River Works
DIBA	:	Data dan informasi bencana aceh
DIBI	:	Data dan Informasi Bencana Indonesia (Indonesian Disaster Information and Data)
DID	:	Department of Irrigation and Drainage
DIPECHO	:	Disaster Preparedness ECHO
DKI	:	Daerah Khusus Ibukota (Special Capital Territory)
DMC	:	Disaster Management Center
DMD	:	Disaster Management Division
DMH	:	Department of Meteorology and Hydrology
DMIS	:	Disaster Management Information System
DMO	:	Disaster Management Order
DMR	:	Department of Mineral Resources
DMRS	:	Disaster Monitoring and Response System
DND	:	Department of National Defence
DOCC	:	Disaster Operations Control Centre
DOE	:	Department Of Environment
DOR	:	Department of Road
DOST	:	Department of Science and Technology

DPRE	:	Disaster Preparedness and Response Education
DPWH	:	Department of Public Works and Highways
DPWT	:	Department of Public Works and Transportation
DREAM	:	Disaster Risk Exposure and Assessment for Mitigation
DRR	:	Disaster Risk Reduction
DRSC	:	Building Disaster Resilient Societies in Central Region in Vietnam
DSS	:	Decision Support System
DVB	:	Digital Video Broadcasting
DWR	:	Department of Water Resources
E		
ECHO	:	The Humanitarian Aid and Civil Protection department of European Commission
EDIS	:	Establishment of Disaster Information Management System
EDM	:	electro-optical distance measurement
EGAT	:	Electricity Generation Authority of Thailand
EM-DAT	:	Emergency Disaster Database
EOC	:	Emergency Operations Center
EOP	:	Emergency Operating Procedures
EOS	:	Emergency Operating System
EP	:	Emergency Preparedness
EP Day	:	Emergency Preparedness Day
EWS	:	Early Warning System
F		
FCC	:	Flood Control Center
FCIC	:	Flood Control Information Center
FFWS	:	Flood Forecasting and Warning System
FLAS	:	Fixed-Line Disaster Alert System
FMRDS	:	FM Radio Data System
G		
GDP	:	Gross Domestic Product
GFDRR	:	Global Facility for Disaster Reduction and Recovery
GIRN	:	Government Integrated Radio Network
GIS	:	Geographic Information System
GIZ	:	Deutsche Gesellschaft für Internationale Zusammenarbeit (German Agency for International Cooperation)
GLIDE	:	GLobal IDEntifier Number
GMS	:	Greater Mekong Sub-region
GPS	:	Global Positioning System
GRDC	:	Geology Research Development Centre
GTS	:	Global Telecommunication System
GTZ	:	Deutsche Gesellschaft für Internationale Zusammenarbeit (German Agency for International Cooperation)
H		
HAII	:	Hydro and Agro Informatic Institute
HFA	:	Hyogo Framework for Actions
HMD	:	Hydro- Meteorological Division
I		
ICHARM	:	International Centre for Water Hazard and Risk Management

ICL	:	International Consortium on Landslides
ICP	:	Incident Command Post
ICT	:	Information and Communication Technology
ID	:	Irrigation Department
I-DRMP	:	Integrated Disaster Risk Management Plan
IM	:	Incident Manager
InaTEWS	:	Indonesia Tsunami Early Warning System
INGO	:	International Non-government Organisation
INSARAG	:	International Search and Rescue Advisory Group
IOTWS	:	Indian Ocean Tsunami Warning and Mitigation System
IPOCM	:	Incident Preparedness and Operational Continuity Management
ISDR	:	International Strategy for Disaster Reduction
ITST	:	Institute of Transport Science and Technology
J		
JAIF	:	Japan-ASEAN Integration Fund
JAXA	:	Japan Aerospace Exploration Agency
JICA	:	Japan International Cooperation Agency
JKR	:	Jabatan Kerja Raya
JMA	:	Japan Meteorological Agency
JMG	:	Minerals and Geoscience Department Malaysia
JPBBN	:	Jawatankuasa Pengurusan dan Bantuan Bencana Negeri (Disaster Aid and Management Committee)
JPT	:	Joint Project Team
JST	:	Japan Science and Technology Agency
K		
KOICA	:	Korea International Cooperation Agency
KOMINFO	:	Kementerian Komunikasi dan Informatika (Ministry of Communication and Information Technology)
L		
LANGOCA	:	Laos Australia NGO Cooperation Agreement
Lao PDR	:	Lao People's Democratic Republic
LAPAN	:	Lembaga Penerbangan dan Antariksa Nasional (National Institute of Aeronautics and Space)
LCD	:	Liquid Crystal Display
LDRRMC	:	Local Disaster Risk Reduction and Management Council
LDRRMF	:	Local Disaster Risk Reduction and Management Fund
LGU	:	Local Government Units
LIPI	:	National Institute of Science
LMAP	:	Land Management and Administration Project
LNMC	:	Lao National Mekong Committee
M		
MACRES	:	Malaysian Centre for Remote Sensing
MAI	:	Ministry of Agriculture and Irrigation
MAPDRR	:	Myanmar Action Plan on Disaster Risk Reduction
MARD	:	Ministry of Agriculture and Rural Development
MAS	:	Myanmar Agriculture Service
MDPA	:	Myanmar Disaster Preparedness Agency
MEC	:	Myanmar Earthquake Committee

MERS	:	Malaysia Emergency Response System
MES	:	Myanmar Engineering Society
MGB	:	Mines and Geosciences Bureau
MGS	:	Myanmar Geosciences Society
MHA	:	Ministry of Home Affairs
MIMU	:	Myanmar information Management Unit
MLSW	:	Ministry of Labour and Social Welfare
MMD	:	Malaysian Meteorological Department
MMDA	:	Metro Manila Development Authority
MNTEWC	:	Malaysian National Tsunami Early Warning Center
MOE	:	Ministry of Education
MOH	:	Ministry of Health
MONRE	:	Ministry of Natural Resources and Environment
MOSTI	:	Ministry of Science, Technology and Innovation
MOWRAM	:	Ministry of Water Resources and Meteorology
MPWT	:	Ministry of Public Works and Transportation
MRC	:	Mekong River Commission
MRCFFG	:	Mekong River Commission Flash Flood Guidance
MRCS	:	Mekong River Commission Secretariat
MRSA	:	Malaysia Remote Sensing Agency
MSS	:	Meteorological Service Singapore
MSWRR	:	Ministry of Social Welfare, Relief and Resettlement
MTSAT	:	Multi-functional Transport Satellite
N		
NADDI	:	National Disaster Data and Information Management System
NAMRIA	:	National Mapping and Resource Information Authority
NASOP	:	National standard operating procedure
NCDCC	:	National Civil Defence Cadet Corps
NCDM	:	National Committee for Disaster Management
NCSR	:	National Committee for Search and Rescue
NDC	:	National Disaster Council
NDMC	:	National Disaster Management Center
NDMC	:	National Disaster Management Committee
NDMO	:	National Disaster Management Office
NDPMC	:	National Disaster Prevention and Mitigation Committee
NDPMP	:	National Disaster Prevention and Mitigation Plan
NDRRMC	:	National Disaster Risk Reduction and Management Council
NDRRMP	:	National Disaster Risk Reduction and Management Plan
NDWC	:	National Disaster Warning Center
NEA	:	National Environment Agency
NFP	:	National Focal Point
NGDC	:	National Geophysical Data Center
NGO	:	Non-governmental Organization
NHMS	:	National Hydro- Meteorological Service
NOAA	:	National Oceanic and Atmospheric Administration
NSC	:	National Security Council
NWPTAC	:	Northwest pacific Tsunami Advisory Center

O

OCD	:	Office of Civil Defence
Ops CE	:	Operation Civil Emergency
OSCP	:	On Scene Command Post
OSPD	:	Outlines of Strategy and Policy for Development

P

PAGASA	:	Philippine Atmospheric, Geophysical and Astronomical Services Administration
PCDM	:	Province Committee for Disaster Management
PCIEERD	:	Philippine Council for Industry, Energy and Emerging Technology Research and Development
PCFSC&SR	:	Provincial Committee for Flood and Storm Control & Search and Rescue
PDMC	:	Province Disaster Management Committee
PFI	:	Private Finance Initiative
PHIVOLCS	:	Philippine Institute of Volcanology and Seismology
PIA	:	Philippine Information Agency
PMO	:	Prime Minister's Office
POKOMAS	:	Kelompok Masyaraka (Flood operation Community Units)
PPT	:	PowerPoint
PTWC	:	Pacific Tsunami Warning Center
PU	:	Pekerjaan Umum (Ministry of Public Works)
PUB	:	Public Utilities Board
PWD	:	Public Works Department
PWS	:	Public Warning System

R

RAEWM	:	Risk Assessment, Early Warning and Monitoring
RDRRMC	:	Regional Disaster Risk Reduction Management Council
READY	:	Hazards Mapping and Assessment for Effective Community-Based Disaster Risk Management
REDAS	:	Rapid Earthquake Damage Assessment System
RFS	:	River Forecasting Section
RID	:	Royal Irrigation Department
RIMES	:	Regional Integrated Multi-Hazard Early Warning System
RISTEK	:	Kementerian Riset dan Teknologi (Ministry of Research and Technology)
RRD	:	Relief and Resettlement Department (Division)
RSM	:	Regional Spectral Model
RTN	:	Royal Thai Navy
RTSP	:	Regional Tsunami Service Provider

S

SATREPS	:	Science and Technology Research Partnership for Sustainable Development
SCDF	:	Singapore Civil Defence Force
SDMRC	:	State Disaster Management and Relief Committee
SEACAP	:	South East Asia Community Access Programme
SEZ	:	Special Economic Zone
SMART	:	Special Malaysia Disaster Assistance and Rescue Team
SMS	:	Short Message Service
SMS	:	Short Messaging System
SNAP	:	Strategic National Action Plan

SNS	:	Social Networking Service
SOP	:	Standard Operating Procedure
SSB	:	Single Side Band
T		
TDMRC	:	Tsunami and Disaster Mitigation Research Center
TMD	:	Thai Meteorological Department
U		
UN	:	United Nation
UN OCHA	:	United Nations Office for the Coordination of Humanitarian Affairs
UNDP	:	United Nations Development Programme
UNESCO	:	United Nations Educational, Scientific and Cultural Organization
UNHCR	:	United Nations High Commissioner for Refugees
UNISDR	:	United Nations International Strategy for Disaster Reduction
UPS	:	Uninterruptible power supply
USFS	:	United States Financial Services
USGS	:	United States Geological Survey
USTATF	:	United States Technical Assistance and Training Facility
V		
VDPU	:	Village Disaster Protection Unit
VNRC	:	Vietnam Red Cross
VSAT	:	Very Small Aperture Terminal
W		
WB	:	World Bank
WMO	:	World Meteorological Organization
WP	:	Work Program
Y		
YSB	:	Yunnan Seismic Bureau

Abbreviations of Measures

Length

mm	=	millimeter
cm	=	centimeter
m	=	meter
km	=	kilometer

Area

ha	=	hectare
m^2	=	square meter
km^2	=	square kilometer

Volume

1, lit	=	liter
m^3	=	cubic meter
m^3/s, cms	=	cubic meter per second
MCM	=	million cubic meter
m^3/d, cmd	=	cubic meter per day

Weight

mg	=	milligram
g	=	gram
kg	=	kilogram
t	=	ton
MT	=	metric ton

Time

sec	=	second
hr	=	hour
d	=	day
yr	=	year

Money

BND	=	Brunei Dollar
KHR	=	Cambodian Riel
IDR	=	Indonesian Rupiah
LAK	=	Lao Kip
MMK	=	Myanmar Kyat
MYR	=	Malaysian Ringgit
PHP	=	Philippine Peso
SGD	=	Singapore Dollar
THB	=	Thai Baht
USD	=	U.S. Dollar
VND	=	Vietnamese Dong

Energy

Kcal	=	Kilocalorie
KW	=	kilowatt
MW	=	megawatt
KWh	=	kilowatt-hour
GWh	=	gigawatt-hour

Others

%	=	percent
o	=	degree
'	=	minute
"	=	second
°C	=	degree Celsius
cap.	=	capital
LU	=	livestock unit
md	=	man-day
mil.	=	million
no.	=	number
pers.	=	person
mmho	=	micromho
ppm	=	parts per million
ppb	=	parts per billion
lpcd	=	litter per capita per day
Mw	=	moment magnitude scale

Exchange Rate

Exchange Rate			August 18, 2012
Country	Currency		Exchange rate to USD (1USD=79.55JPY)
Brunei	BND	Brunei Dollar	1.2538
Cambodia	KHR	Cambodian Riel	4,068
Indonesia	IDR	Indonesian Rupiah	9,490
Lao PDR	LAK	Lao Kip	7,982.5
Malaysia	MYR	Malaysian Ringgit	3.1315
Myanmar	MMK	Myanmar Kyat	875.5
Philippines	PHP	Philippine Peso	42.4
Singapore	SGD	Singapore Dollar	1.2538
Thailand	THB	Thai Baht	31.51
Vietnam	VND	Vietnamese Dong	20,845

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CHAPTER 1 INTRODUCTION

1.1 Background

The frequency of natural disasters has been increasing for the last 30 years and has caused tremendous damages and loss of life. About 90% of the damages/losses were concentrated in the ASEAN region where natural disasters are one of the serious concerns, not only from a humanitarian but also from an economic and industrial point of view.

1.2 AADMER, HFA and AADMER Work Program

Under such circumstance, ten member countries of the ASEAN accorded with “the ASEAN Agreement on Disaster Management and Emergency Response (AADMER)” on July 26, 2005 (ratified on December 24, 2009). The AADMER was established in order to strengthen the disaster management structure in the region for the implementation of the Hyogo Framework for Actions (HFA) 2005-2015.

In relation to the activities above, the ASEAN Committee for Disaster Management (ACDM) adopted the “AADMER Work Program 2010-2015” as guideline of activities for the AADMER during its 15th Meeting last March 2010 held in Singapore.

1.3 AHA Centre

At the same time, the ASEAN countries recognized the necessity to establish “the ASEAN Coordination Centre for Humanitarian Assistance on Disaster Management (AHA Centre)” and set up as a provisional status in Jakarta, Indonesia in October 2007.

At the first phase of the AADMER Work Program 2010-2015, the AHA Centre was formally established in November 2011 at the ASEAN Summit Meeting in Bali, Indonesia; and will be ratified in due time. The AHA Centre has started various activities such as assistance in the procurement of facilities/equipment, provision of technical support, and so on from donors including Japan.

1.4 Cooperation between ASEAN and Japan

On the other hand, Japan and the ASEAN continually reaffirmed their mutual cooperation in disaster management on three occasions; first at the Special Japan-ASEAN Ministerial Meeting in Jakarta on April 9, 2011 held soon after the Great East Japan Great Earthquake; second, at the ASEAN Post Ministerial Conference held last July 21, 2011; and lastly, at the Japan-ASEAN Summit on November 18, 2011. At the meeting/conference, Japan has expressed its commitment to support the activities of AHA Centre not only directly, but also through bilateral cooperation with each ASEAN country for regional natural disaster management.

1.5 Data Collection Survey

The activities of the AHA Centre have just started and not much information even fundamentals on natural disasters and disaster management of the ASEAN countries were gathered.

Therefore, the Japan International Cooperation Agency (JICA) has decided to conduct “the Data Collection Survey on ASEAN Regional Collaboration in Disaster Management” for considerations of future plans of assistance to the AHA Centre and each ASEAN country in the field of natural disaster management.

1.6 Purposes of the Survey

The purposes of the survey are as follows:

- To collect basic information on disaster management of ASEAN countries;
- To conduct needs and potential assessment for the development of disaster management in the ASEAN region; and
- To propose an ASEAN guideline/reference for flood risk assessment.

1.7 Outputs To Be Expected

- Inventory of information on disaster management of each ASEAN country.
- List of programs/projects/schemes for future assistance for disaster management.
  - Bilateral assistance
  - Regional assistance
- ASEAN guideline/reference for flood risk assessment.

CHAPTER 2 ASEAN HAZARD PROFILE

2.1 General Characteristics of the Natural Disasters in the ASEAN Region

The ASEAN countries are geographically located in Southeast Asia and north of the Australian continent. The region is generally situated in tropical areas characterized with a hot and humid climate zones with exception to the north-western part which experiences a humid sub-tropical climate. The region receives plentiful of rainfall and remains humid in years. Generally, the countries have dry and wet seasons due to seasonal shifts in monsoon, while the mountainous areas in the northern part have a milder and drier climate at high altitude.

The ASEAN region is geographically diverse and includes high hills, rugged mountains, elevated plateaus, highlands, floodplains, coastal plains, and deltas underlined by various types of geology. The region is also home to large river systems such as the Mekong River and Ayeyarwady River, and major water bodies such as the Tonle Sap and Lake Tobe. There are several tectonic plates in the region that causes earthquakes, volcanic eruptions, and tsunamis. Also located are two great oceans of the Pacific and the Indian where seasonal typhoons or cyclones and tsunami originate. All these natural set-up are background on the history of devastating disasters of various types that have caused economic and human losses across the regions.

Hereafter, Chapter 2 describes an overview of the disasters in ASEAN regions for the past 32 years from 1980 to 2011 based mainly on the data from "EM-DAT: The OFDA/CRED International Disaster Database: www.emdat.be - Université Catholique de Louvain - Brussels – Belgium.[1]" "Criteria and definitions" by EM-DAT; and the full set of data used in this chapter are shown in Chapter 2.6.

The Team notes that there are such issues in EM-DAT to be improved/ clarified that definitions of some hazards including multi-hazard are unclear, disasters of small scales are not, so on. However, this data base is considered useful when outlines of disasters among different states are compared on a same assumption. The Team presents this chapter with intention that ASEAN states may share the knowledge of disasters in neighboring states and that the states may re-recognize that a data base on the basis of the unified ASEAN criteria, instead of EM-DAT, should be needed for detail analysis/understanding of disasters in the ASEAN region.

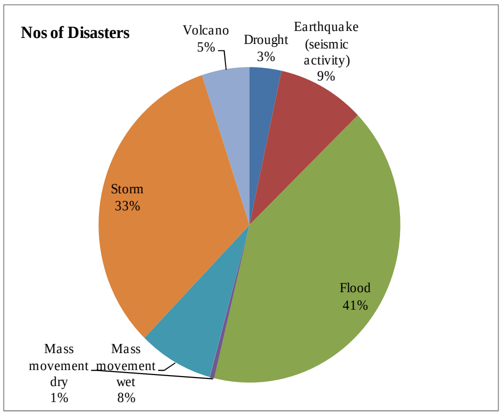
In addition, the sub-chapter 7.2 describes an ASEAN hazard profile with the data that exclude the large scale hazards that had occurred recently, because those hazards might mask prevailing yearly hazard feature. The excluded hazards were 2004 Sumatra Earthquake, 2008 Cyclone Nargis, 2009 Typhoon Ondoi/Ketsana, and 2011 Chao Phraya river flood of Thailand.

[1]Among other data set categorized as natural disaster in EM-DAT, "epidemic", "insect infestation" and "wildfire" are not included in this survey.

2.2 Natural Disasters in the ASEAN Region

<u>Number of Natural Disasters:</u>

Figure 2.2.1 shows that in 1980-2011, 41% of the total number of disasters in the ASEAN region was due to flooding, followed by storms (33%). ‘Storms[2]’ and ‘floods’ (water related hazard totaling to about 74%) are the most frequent hazards in the region. It may be noted that the ‘mass movement’ has similar frequency as the earthquake, implying that mass movement/sediment disasters may not be negligible in the ASEAN region.



Disasters from 1980 to 2011	Nos of Disasters	%
Drought	36	3.4%
Earthquake (seismic activity)	99	9.4%
Flood	433	41.0%
Mass movement dry	5	0.5%
Mass movement wet	85	8.0%
Storm	344	32.6%
Volcano	54	5.1%
Total	1,056	100.0%

Data from 1980 to 2011
Source: "EM-DAT: The OFDA/CRED International Disaster Database
www.emdat.be - Université Catholique de Louvain - Brussels - Belgium"
Presentation: JICA Study Team (2012)

Figure 2.2.1 Nos. of Natural Disasters in ASEAN Region (1980-2011)

<u>Total Number of Affected People</u>:

Figure 2.2.2 shows the total number of affected people. About 47% of the total number of people was affected due to ‘storm’ followed by ‘flood’ (33%). Water related hazards totaled to 80% and have significant impact on the people in the ASEAN region (Figure 2.2.2 above). On the other hand, ‘drought’ affects a large number of people per event followed by ‘storm’ and ‘flood’ (Figure 2.2.2 below), implying that ‘drought’ prevails in wider areas of the region.

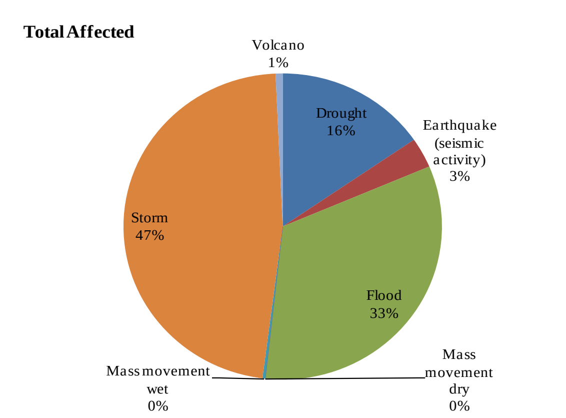
<u>Total Number of Deaths</u>:

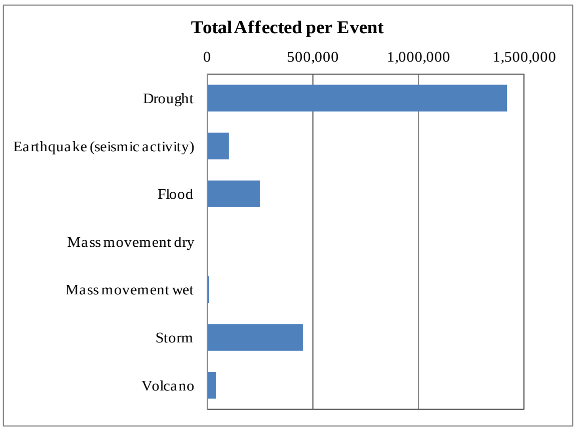
Figure 2.2.3 shows that 49% of deaths were due to ‘earthquake’ followed by ‘storm (45%)’; these two disasters take 94% of the total death from natural disasters (Figure 2.2.3 above). In particular, ‘earthquakes[3] (including tsunamis)’ have the largest number of ‘death per event’ (Figure 2.2.3 middle), implying its devastating effects on human lives even with one occurrence.

It should be noted that in case of ‘mass movement (dry)’, 80% of affected people had been killed (Figure 2.2.3 below) that is the remarkable characteristic of the disaster of ‘mass movement (dry)’. Mass movement (dry) will have fatal impacts on human who are to be involved.

[2] EM-DAT defines: Severe Storm: A severe storm or thunderstorm is the result of convection and condensation in the lower atmosphere and the accompanying formation of a cumulonimbus cloud. A severe storm usually comes along with high winds, heavy precipitation (rain, sleet, hail), thunder and lightning”

[3] EM-DAT does not include the terminology ‘tsunami’ in the ‘disaster type’ of the data base of July version.

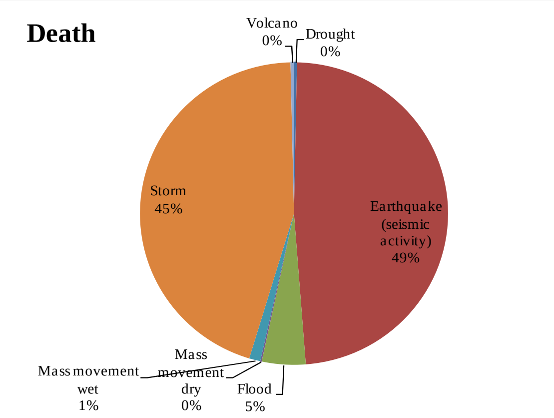


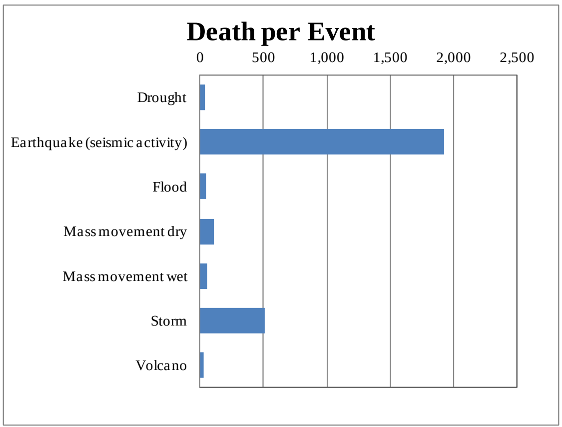


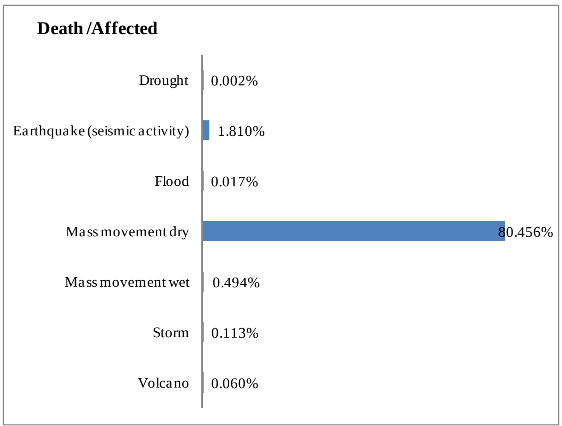
Total Affected	Total Affected	%	Nos of Disasters	Total Affected per event
Drought	51,030,144	15.4%	36	1,417,504
Earthquake (seismic activity)	10,526,945	3.2%	99	106,333
Flood	109,697,680	33.1%	433	253,343
Mass movement dry	701	0.0%	5	140
Mass movement wet	939,325	0.3%	85	11,051
Storm	156,402,854	47.3%	344	454,659
Volcano	2,358,679	0.7%	54	43,679
Total	330,956,328	100%	1,056	2,286,710

Data from 1980 to 2011
Data Source: "EM-DAT: The OFDA/CRED International Disaster Database
www.emdat.be - Université Catholique de Louvain - Brussels - Belgium"
Presentation: JICA Study Team (2012)

Figure 2.2.2 Total Number of Affected People in the ASEAN Region (1980-2011)







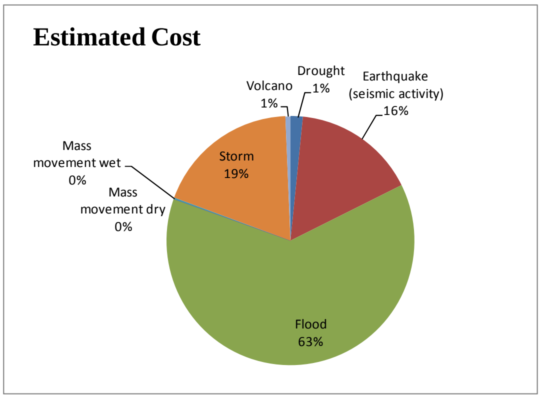
Death	Death	%	Nos of Disasters	Death per event	Death /Affected
Drought	1,274	0.3%	36	35	0.002%
Earthquake (seismic activity)	190,489	48.4%	99	1,924	1.810%
Flood	18,115	4.6%	433	42	0.017%
Mass movement dry	564	0.1%	5	113	80.456%
Mass movement wet	4,643	1.2%	85	55	0.494%
Storm	176,706	44.9%	344	514	0.113%
Volcano	1,409	0.4%	54	26	0.060%
Total	393,200	100%	1,056	2,709	0.119%

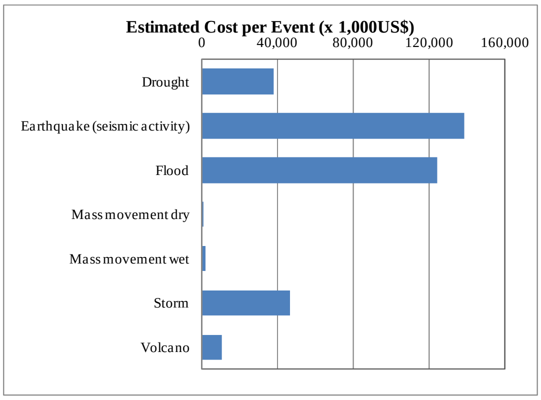
Data from 1980 to 2011
Data Source: "EM-DAT: The OFDA/CRED International Disaster Database
www.emdat.be - Université Catholique de Louvain - Brussels - Belgium"
Presentation: JICA Study Team (2012)

Figure 2.2.3 Total Number of Deaths in the ASEAN Region (1980-2011)

Estimated Cost per Disaster:

Figure 2.2.4 shows that 63% of the estimated cost of disasters in the ASEAN region is due to flooding followed by 'storm (19%)' and 'earthquake (16%)'. This implies that flood disasters have caused serious economic damages in the ASEAN region for the past 32 years (1980-2011).Among the estimated cost due to flood about 37% (45.7 million USD) is due to the flood in Thailand (2011). This event indicates that natural disasters striking industrial areas will cause great economic losses. On the other hand, earthquake disasters (including 'tsunami') have the largest number in estimated cost per event followed by flood, implying its destructive effects on tangibles that can be converted to cost.





Estimated Cost	Estimated Cost	%	Nos of Disasters	Estimated Cost per event
Drought	1,365,873	1.6%	36	37,941
Earthquake (seismic activity)	13,733,201	16.0%	99	138,719
Flood	53,771,117	62.8%	433	124,183
Mass movement dry	1,000	0.0%	5	200
Mass movement wet	156,326	0.2%	85	1,839
Storm	16,024,450	18.7%	344	46,583
Volcano	560,472	0.7%	54	10,379
Total	85,612,439	1	1,056	359,844

Data from 1980 to 2011
Data Source: "EM-DAT: The OFDA/CRED International Disaster Database www.emdat.be - Université Catholique de Louvain - Brussels - Belgium"
Presentation: JICA Study Team (2012)

(x 1,000US$)

Figure 2.2.4 Estimated Cost per Disaster in the ASEAN Region (1980-2011) (x US$1,000)

2.3 Disaster Prone States in the ASEAN Region

Number of Disasters by State:

Figure 2.3.1 shows that Philippines experienced the largest share of disaster occurrence (384 times) among the ASEAN states in 1980-2011, followed by Indonesia (296 times). Brunei and Singapore did not suffer any disasters that caused death of ten or more. Philippines and Indonesia have such similar characteristics which frequently experience various disasters such as earthquake/tsunami, volcanic eruptions, and landslides.

Total Number of Affected People by State:

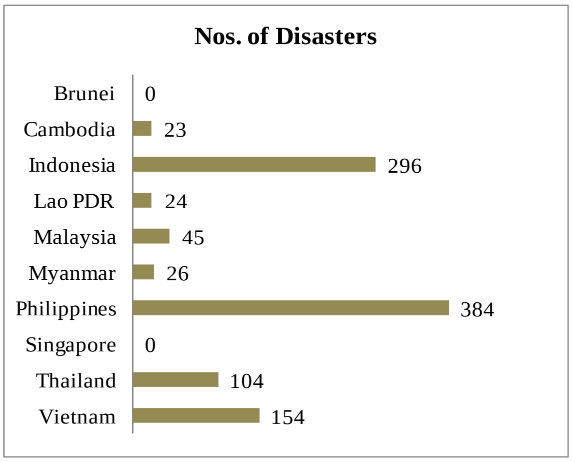
Figure 2.3.2 shows that the Philippines has the largest number of affected people followed by Thailand and Vietnam; whereas Indonesia placed fourth on having the largest number of affected people despite the fact it placed second from having the largest share of disaster occurrence (Figure 2.3.1). This is because that Indonesia shows the least 'total affected people' among those four countries (see Figure 2.4.4).

Number of Death by State:

Figure 2.3.3 shows that Indonesia suffered the largest number of death possibly due to the earthquake that occurred in 2004. Myanmar came next where Cyclone Nargis in 2008 killed a large number of people.

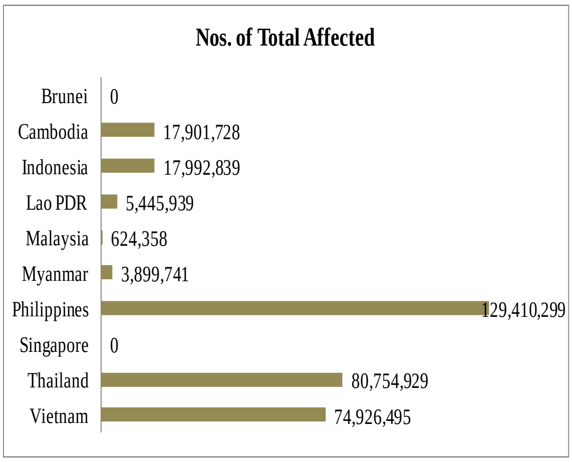
<u>Estimated Cost by State</u>:

Figure 2.3.4 shows that Thailand suffered a huge cost of damage due to the flood in 2011; followed by Indonesia due to the Sumatra earthquake in 2004. A peculiar characteristic is that the estimated damage cost in Thailand was remarkably high while other indicators (the numbers of disasters, affected people, and death) were more or less the same with other countries. This is because the 2011 flood affected the industrial areas and caused huge economic losses.



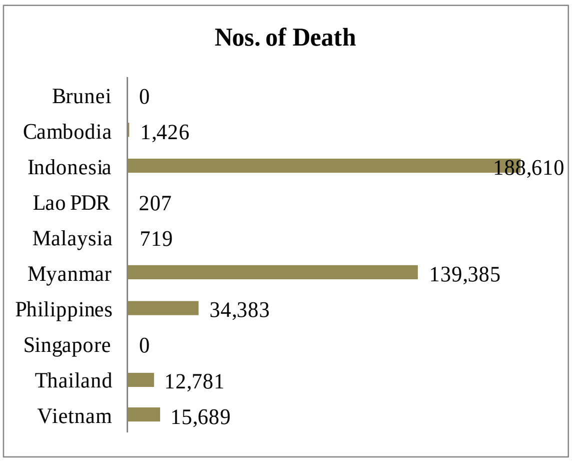
Data from 1980 to 2011
Data Source: "EM-DAT: The OFDA/CRED International Disaster Database www.emdat.be - Université Catholique de Louvain - Brussels - Belgium"
Presentation: JICA Study Team (2012)

Figure 2.3.1 Number of Disaster by State in the ASEAN Region (1980-2011)



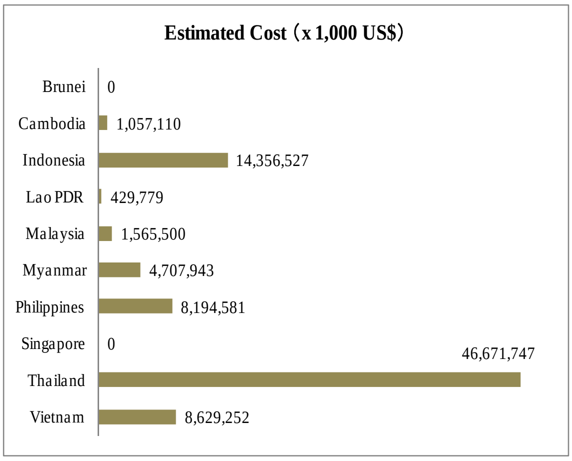
Data from 1980 to 2011
Data Source: "EM-DAT: The OFDA/CRED International Disaster Database www.emdat.be - Université Catholique de Louvain - Brussels - Belgium"
Presentation: JICA Study Team (2012)

Figure 2.3.2 Total Number of Affected People by State in the ASEAN Region (1980-2011)



Data from 1980 to 2011
Data Source: "EM-DAT: The OFDA/CRED International Disaster Database www.emdat.be - Université Catholique de Louvain - Brussels - Belgium"
Presentation: JICA Study Team (2012)

Figure 2.3.3 Total Number of Death by State in the ASEAN Region (1980-2011)



Data from 1980 to 2011
Data Source: "EM-DAT: The OFDA/CRED International Disaster Database www.emdat.be - Université Catholique de Louvain - Brussels - Belgium"
Presentation: JICA Study Team (2012)

Figure 2.3.4 Estimated Cost by State in the ASEAN Region (1980-2011) (x US$1,000)

2.4 Outline of Natural Disaster According to the Hazard

Drought:

Figure 2.4.1 shows that drought occurs in most ASEAN countries except for Singapore and Brunei. There may have been data acquisition error in Myanmar where no data is available. Affected people are concentrated in Thailand followed by Vietnam, Philippines, and Cambodia. A considerable number of deaths from drought were recorded in Indonesia, since severe droughts were experienced in 1982, 1984, and 1997. Whereas, considerable estimated economic losses in agriculture were recorded in Vietnam and Thailand. These three countries seem to be drought-prone areas.

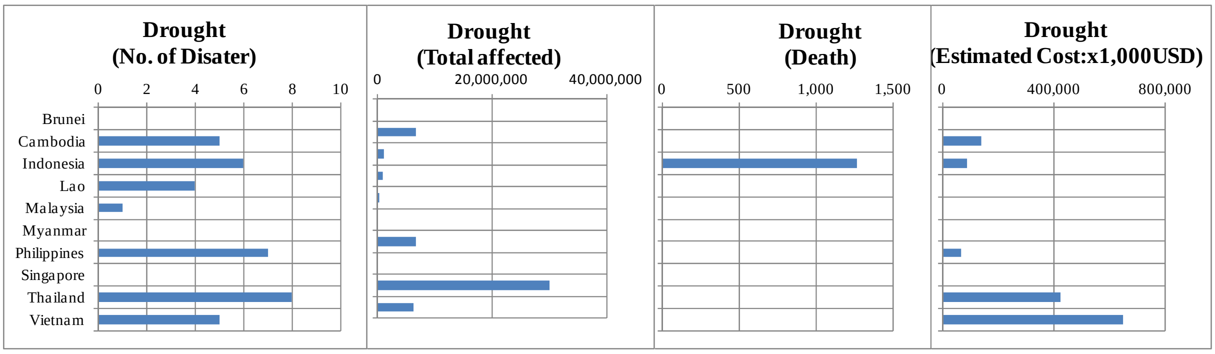


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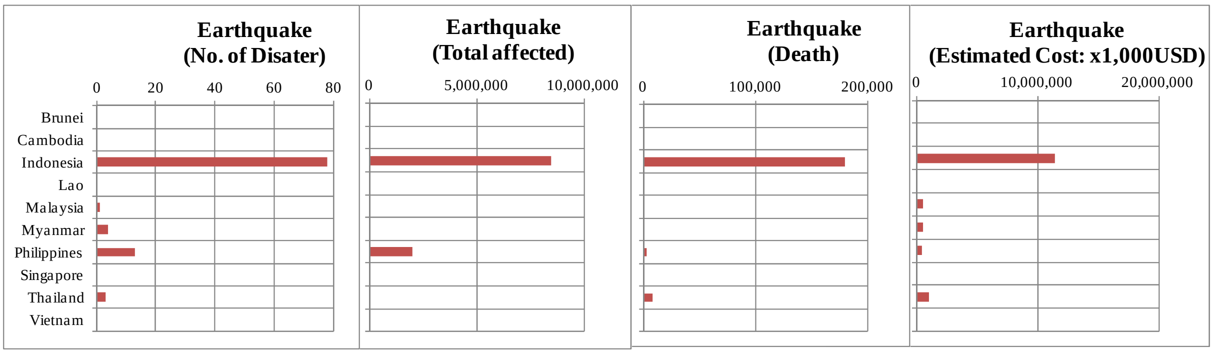
Figure 2.4.1 Outline of Natural Disaster According to Drought

Earthquake:

Figure-2.4.2 shows that Indonesia is the most earthquake-prone state followed by Philippines and Thailand.



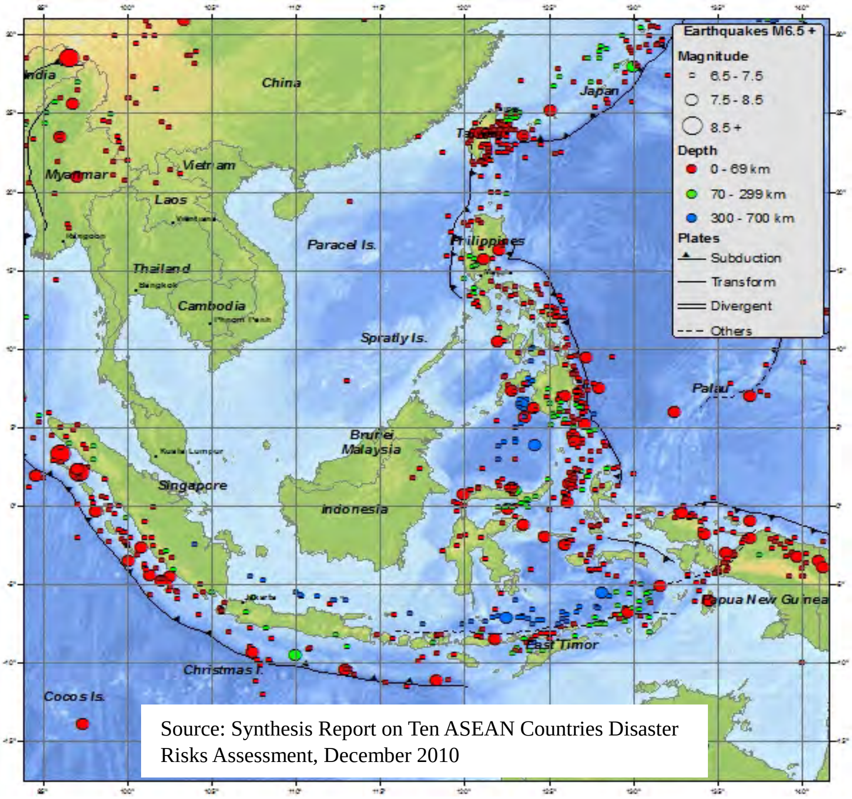
Data from 1980 to 2011; Created in: Jul-2012. - Data version: v12.07; Data Source: "EM-DAT: The OFDA/CRED International Disaster Database; www.emdat.be - Université Catholique de Louvain - Brussels - Belgium"; Presentation: JICA Study Team (2012)

Figure 2.4.2 Outline of Natural Disaster According to Earthquake Hazard

Earthquakes in ASEAN countries have occurred mainly in Indonesia, where all the indicators are the highest among the 10 countries. In the past of 23 years (1980 -2011), 78 earthquakes are recorded causing 800 thousands of affected people, 180 thousand of death (out of which 136 thousands were due to 2004 Sumatra Island Earthquake).

Strong earthquakes experienced in ASEAN region such as the Sumatra earthquake in 2004 (Indonesia, Mw=9.1~9.3), earthquake in Luzon island in 1990 (Philippine, Mw=7.9) and others have caused severe damages on countries located close to the boundaries of the tectonic plates near Indonesia and Philippines as shown in Figure 2.4.3. The tsunami generated by the Sumatra earthquake in 2004 caused great damages to coastal areas in countries facing the Indian Ocean. The damages brought about by the tsunami disaster not only affected the countries in the ASEAN region such as Indonesia, Thailand, and Myanmar, but also to other countries outside ASEAN. Earthquakes occurring in areas of tectonic boundaries therefore will be of greatest concern in the ASEAN region.

Furthermore, earthquakes occurring along in-land active faults also need to be given serious attention. The Sagaing Fault in Myanmar is one of these, which caused serious damages to towns along the fault and any movements are expected to occur in the near future.

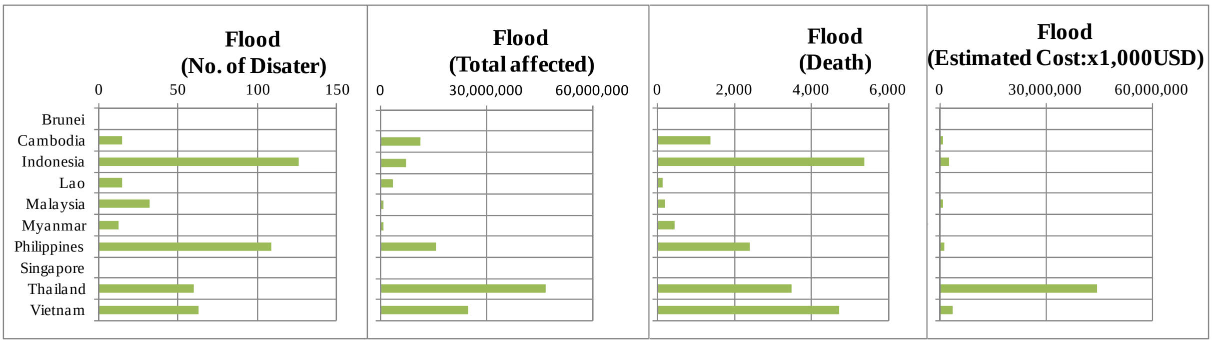


Source: Synthesis Report on Ten ASEAN Countries Disaster Risks Assessment, December 2010

Figure 2.4.3 Epicenter of Earthquakes with Magnitudes 6.5 or more in the ASEAN Region

Flood:

Figure 2.4.3 shows that flood occurred in all ASEAN countries except for Brunei and Singapore. Many people were affected and even killed in Indonesia, Philippines, Thailand, and Vietnam. These four countries are considered to be flood-prone countries. In addition, Thailand is remarkable in the graph of 'estimated cost' that is due to the great flood disaster in 2011.

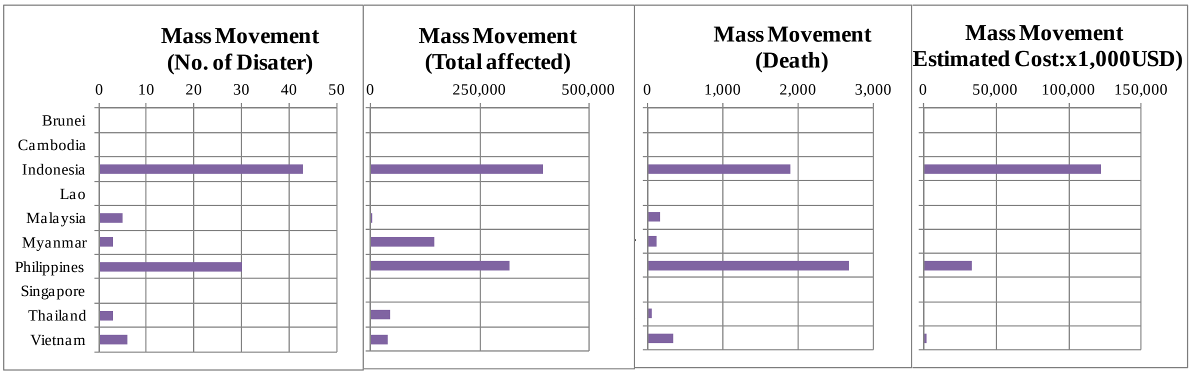


Data from 1980 to 2011; Created in: Jul-2012. - Data version: v12.07; Data Source: "EM-DAT: The OFDA/CRED International Disaster Database; www.emdat.be - Université Catholique de Louvain - Brussels - Belgium"; Presentation: JICA Study Team (2012)

Figure 2.4.4 Outline of Natural Disaster According to Flood

Mass Movement/Sediment Disaster:

Figure 2.4.5 shows that mass movement/sediment disasters frequently occurred in Indonesia and in the Philippines. The total number of affected people, death, and estimated cost were remarkably high in these two countries. This may be attributed to the vulnerable geology of volcanic origin. A massive landslide killed 1,126 people in Leyte Province, Philippines in 2006.



Data from 1980 to 2011; Created in: Jul-2012. - Data version: v12.07; Data Source: "EM-DAT: The OFDA/CRED International Disaster Database; www.emdat.be - Université Catholique de Louvain - Brussels - Belgium"; Presentation: JICA Study Team (2012)

Figure 2.4.5 Outline of Natural Disaster According to Mass Movement/ Sediment Disaster

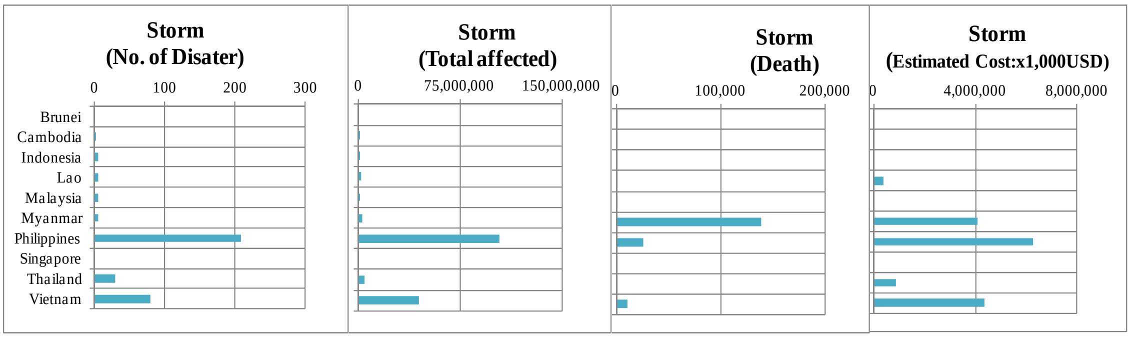
It was noted that a lot of people suffered from landslides in Vietnam, Thailand, Myanmar, and Malaysia in addition to the Philippines and Indonesia; a large scale debris flow buried 14 people in Krabi and Nakhon Si Thammarat provinces, Thailand in 2011.

Recently, sediment disaster has occurred more frequently due to global climate change, rapid urbanization, and deforestation.

Storm:

Figure 2.4.6 shows that storms occur most frequently in the Philippines followed by Vietnam and Thailand, affecting many people and causing death. In Myanmar, though the frequency of storm is not so high as compared with the Philippines and Vietnam, the death and estimated damage cost were considerably high. In particular, the number of death exceeded to 100,000 due to Cyclone Nargis in 2008.

(Cost x 1,000US$)

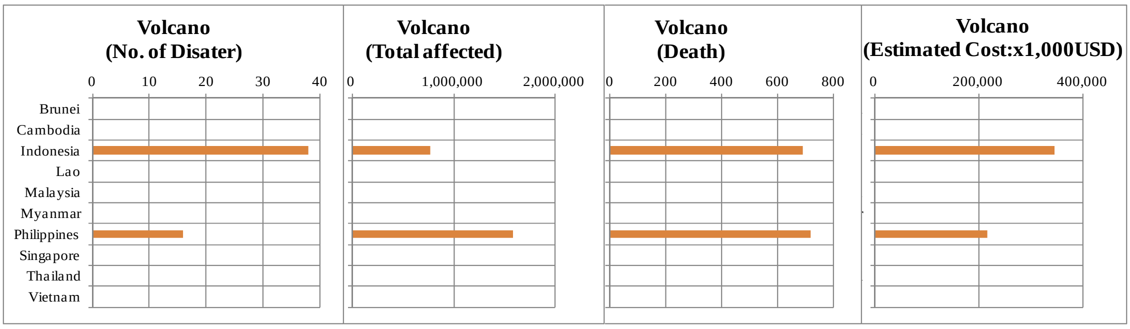


Data from 1980 to 2011; Created in: Jul-2012. - Data version: v12.07; Data Source: "EM-DAT: The OFDA/CRED International Disaster Database; www.emdat.be - Université Catholique de Louvain - Brussels - Belgium"; Presentation: JICA Study Team (2012)

Figure 2.4.6 Outline of Natural Disaster According to Storm

Volcanic Eruption:

Figure 2.4.7 shows that volcano hazard occurred only in the Philippines and Indonesia, which are both located close to the boundaries of tectonic plates (see Figure 2.4.8).



Data from 1980 to 2011; Created in: Jul-2012. - Data version: v12.07; Data Source: "EM-DAT: The OFDA/CRED International Disaster Database; www.emdat.be - Université Catholique de Louvain - Brussels - Belgium"; Presentation: JICA Study Team

Figure 2.4.7 Outline of Natural Disaster According to Volcanic Eruption

In Indonesia, there are 129 volcanoes, out of these, 80 are active. The eruption of Tambora Volcano in 1815 recorded 92,000 fatalities. The eruption of Krakatau Volcano in 1883 and the tsunami caused by the sector collapse of volcanic body killed 36,600 people. Mt. Merapi erupted in 2010 which killed 323 people and about 152,000 people suffered.

In the Philippines, there are about 220 volcanoes, out of these, 23 are active. Mayon Volcano erupted in 1968, 1978, 1993, 2000, and 2001. The eruption in 1993 caused 70 fatalities and

60,000 people were evacuated. The Mt. Pinatubo eruption in 1991 left more than 900 people killed or missing, and more than 90,000 people were evacuated to safer grounds.

Source: Synthesis Report on Ten ASEAN Countries Disaster Risks Assessment, December 2010

Figure 2.4.8 Volcanoes in the ASEAN Region

2.5 Outline of Natural Disasters in Member States

Brunei:

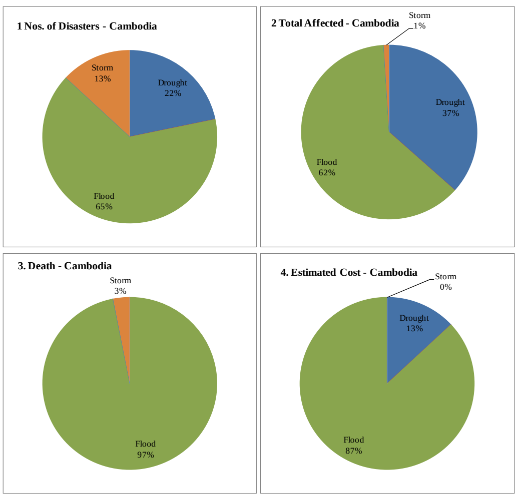
No particular disaster was reported for the past 32 years from 1980 to 2011 according to EM-DAT database.

Cambodia:

Figure 2.5.1 shows that 65% of the total number of disasters occurred in 1980-2011 were related to flood followed by drought (22%). It was noted that 75% of the disaster experienced were "water related hazard" (flood 65% and storm 13%). Similarly, flood affected 62% of the total number of people followed by drought (37%). However, all death caused by disaster were due to "water related hazard" (flood and storm), though most of the estimated damage cost were due to flood (87%) and drought (13%). Flood, storm, and drought are the major disasters in Cambodia.

Indonesia:

Figure 2.5.2 shows the various types of disasters occurred in Indonesia such as flooding (43%), earthquake (26%), mass movement-wet (14%), and volcanic eruption (13%). Earthquake (47%) and flood (41%) disrupted 88% of the total number of affected people. On the other hand, earthquake caused the highest number of death (95% of the total death) and significant economic losses to 79% of the total estimated damage cost as shown in Figure 2.5.2. This is mainly due to the Sumatra Earthquake in 2004 and Java Earthquake in 2006. Flooding and earthquake will be the two major disasters that have great impact in Indonesia.

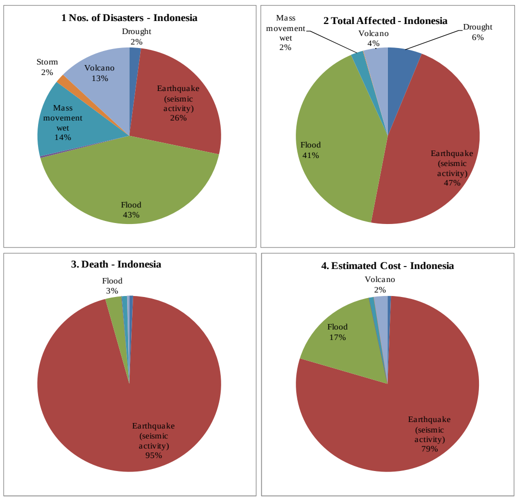


	Drought	Earthquake (seismic activity)	Flood	Mass movement dry	Mass movement wet	Storm	Volcano	Total
1 Nos. of Disasters - Cambodia	5	0	15	0	0	3	0	23
2 Total Affected - Cambodia	6,550,000	0	11,173,637	0	0	178,091	0	17,901,728
3. Death - Cambodia	0	0	1,382	0	0	44	0	1,426
4. Estimated Cost - Cambodia	138,000	0	919,100	0	0	10	0	1,057,110

Data from 1980 to 2011
Data Source: "EM-DAT: The OFDA/CRED International Disaster Database
www.emdat.be - Université Catholique de Louvain - Brussels - Belgium"
Presentation: JICA Study Team (2012)

Cost (x 1,000US$)

Figure 2.5.1
Outline of Natural Disasters in Cambodia



	Drought	Earthquake (seismic activity)	Flood	Mass movement dry	Mass movement wet	Storm	Volcano	Total
1 Nos. of Disasters - Indonesia	6	78	126	1	42	5	38	296
2 Total Affected - Indonesia	1,083,000	8,438,429	7,290,138	701	392,967	14,638	772,966	17,992,839
3. Death - Indonesia	1,266	179,378	5,382	131	1,757	6	690	188,610
4. Estimated Cost - Indonesia	89,000	11,349,576	2,452,016	1,000	120,745	0	344,190	14,356,527

Data from 1980 to 2011
Data Source: "EM-DAT: The OFDA/CRED International Disaster Database
www.emdat.be - Université Catholique de Louvain - Brussels - Belgium"
Presentation: JICA Study Team (2012)

Cost (x 1,000US$)

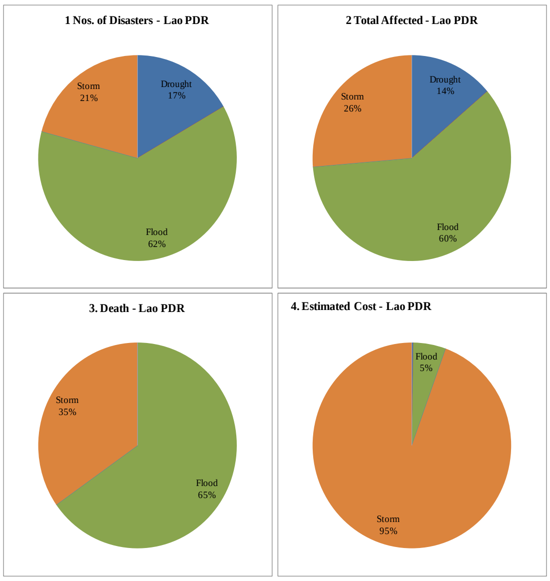
Figure 2.5.2
Outline of Natural Disasters in Indonesia

Lao PDR:

Figure 2.5.3 shows that the major natural disasters in Lao People's Democratic Republic **(**PDR) are flooding, storm, and drought in terms of number of disaster (flood: 62%, storm: 21%, and drought: 17%), and total number of affected people (flood: 60%, storm: 26%, and drought: 14%). On the other hand, deaths due to disasters were attributed to flooding (65%) and storm (35%). Estimated damage costs were caused by storm (95%) and flood (5%). The number of deaths was reported due to drought. It may be considered that people are affected mainly by flood (water) whereas economic losses are mainly caused by storms (considered from its strong winds).

Malaysia:

Figure 2.5.4 shows that 71% of the total number of disasters was caused by floods followed by storm (14%) which affected 90% and 8% number of people, respectively. On the other hand, people were killed not only by floods (27%) and storm (38%) but also due to mass movement (wet and dry) (24%) and earthquake (11%) that attributed to 35% of the total death due to disasters. Flooding (65%) and earthquake (32%) are the two major causes of estimated damage cost. Though flooding, storm, and earthquake will be the major three disasters, mass movement (-wet, -dry) is also a noteworthy disaster that affects human life.

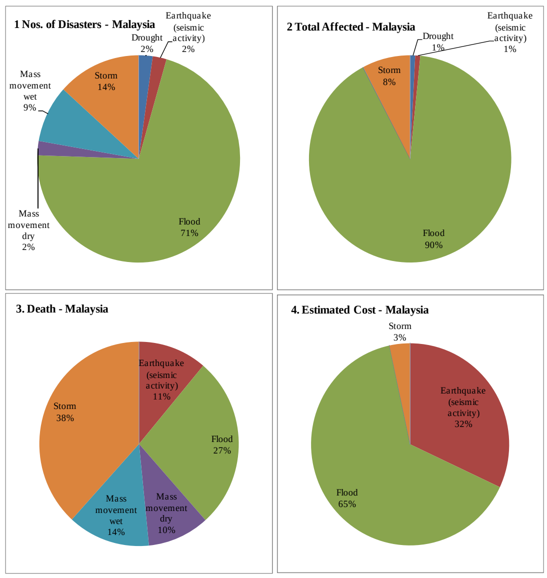


	Drought	Earthquake (seismic activity)	Flood	Mass movement dry	Mass movement wet	Storm	Volcano	Total
1 Nos. of Disasters - Lao PDR	4	0	15	0	0	5	0	24
2 Total Affected - Lao PDR	750,000	0	3,259,740	0	0	1,436,199	0	5,445,939
3. Death - Lao PDR	0	0	135	0	0	72	0	207
4. Estimated Cost - Lao PDR	1,000	0	22,828	0	0	405,951	0	429,779

Data from 1980 to 2011
Data Source: "EM-DAT: The OFDA/CRED International Disaster Database
www.emdat.be - Université Catholique de Louvain - Brussels - Belgium"
Presentation: JICA Study Team (2012)

Cost (x 1,000US$)

Figure 2.5.3
Outline of Natural Disasters in Lao PDR



	Drought	Earthquake (seismic activity)	Flood	Mass movement dry	Mass movement wet	Storm	Volcano	Total
1 Nos. of Disasters - Malaysia	1	1	32	1	4	6	0	45
2 Total Affected - Malaysia	5,000	5,063	566,058	0	291	47,946	0	624,358
3. Death - Malaysia	0	80	196	72	96	275	0	719
4. Estimated Cost - Malaysia	0	500,000	1,012,500	0	0	53,000	0	1,565,500

Data from 1980 to 2011
Data Source: "EM-DAT: The OFDA/CRED International Disaster Database
www.emdat.be - Université Catholique de Louvain - Brussels - Belgium"
Presentation: JICA Study Team (2012)

Cost (x 1,000US$)

Figure 2.5.4
Outline of Natural Disasters in Malaysia

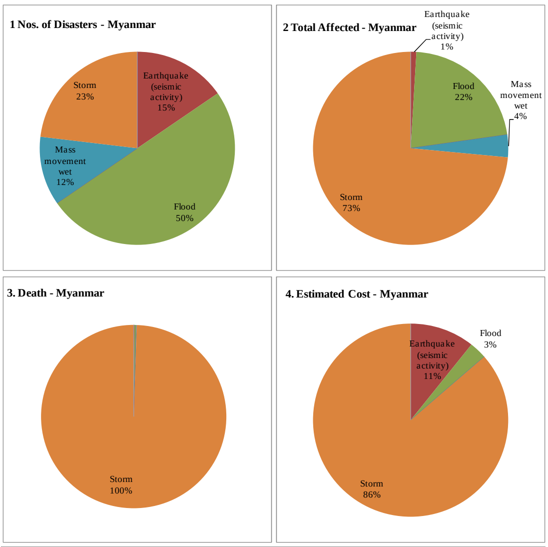
Myanmar:

Figure 2.5.5 shows that 50% of the total number of disasters in Myanmar was related to floods followed by storm (23%), earthquake (15%), and mass movement-wet (12%), whereas 73% of the total affected people by disasters were due to storm followed by floods (22%) in

1980-2011. Similarly, storm (100%) is a major cause of disaster-related death and biggest estimated damage cost (86%). Earthquake (11%) and flood (3%) are next on the estimated damage cost. This pattern of disasters is due to Cyclone Nargis in 2008 t affected 2,400,000 people, left 138,000 fatalities and estimated damage cost of US$4,000,000 to Myanmar.

Philippines:

Figure 2.5.6 shows that storm is the most frequent disaster occurring (55% of the total number of disasters) in Philippines causing 80% of total affected people, 76% of total death, and 76% of estimated cost (damage) followed by flood and earthquake. Mass movement caused a similar number of deaths as to the earthquake and flood though mass movement does not show a significant estimated cost (economic loss). This may be because mass movement occurred mainly in rural mountainous areas in the Philippines.

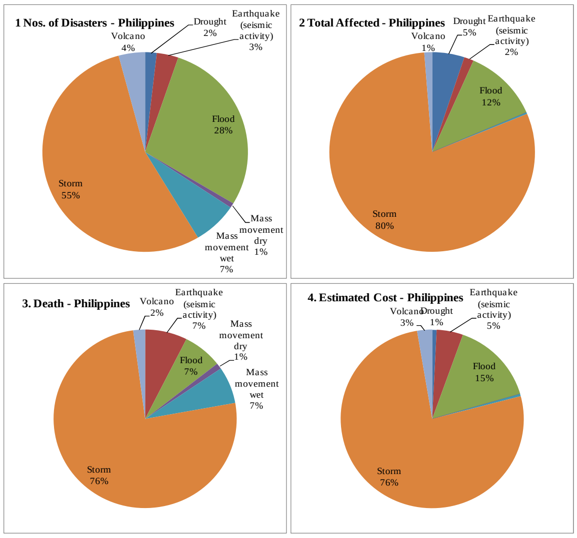


	Drought	Earthquake (seismic activity)	Flood	Mass movement dry	Mass movement wet	Storm	Volcano	Total
1 Nos. of Disasters - Myanmar	0	4	13	0	3	6	0	26
2 Total Affected - Myanmar	0	37,137	850,112	0	146,367	2,866,125	0	3,899,741
3. Death - Myanmar	0	145	422	0	109	138,709	0	139,385
4. Estimated Cost - Myanmar	0	503,600	136,655	0	0	4,067,688	0	4,707,943

Data from 1980 to 2011
Data Source: "EM-DAT: The OFDA/CRED International Disaster Database
www.emdat.be - Université Catholique de Louvain - Brussels - Belgium"
Presentation: JICA Study Team (2012)

Cost (x 1,000US$)

Figure 2.5.5
Outline of Natural Disasters in Myanmar



	Drought	Earthquake (seismic activity)	Flood	Mass movement dry	Mass movement wet	Storm	Volcano	Total
1 Nos. of Disasters - Philippines	7	13	109	3	27	209	16	384
2 Total Affected - Philippines	6,549,542	1,979,293	15,414,285	0	317,516	103,563,950	1,585,713	129,410,299
3. Death - Philippines	8	2,540	2,396	361	2,304	26,055	719	34,383
4. Estimated Cost - Philippines	64,453	380,025	1,234,883	0	33,281	6,265,657	216,282	8,194,581

Data from 1980 to 2011
Data Source: "EM-DAT: The OFDA/CRED International Disaster Database
www.emdat.be - Université Catholique de Louvain - Brussels - Belgium"
Presentation: JICA Study Team (2012)

Cost (x 1,000US$)

Figure 2.5.6
Outline of Natural Disasters in Philippines

Singapore:

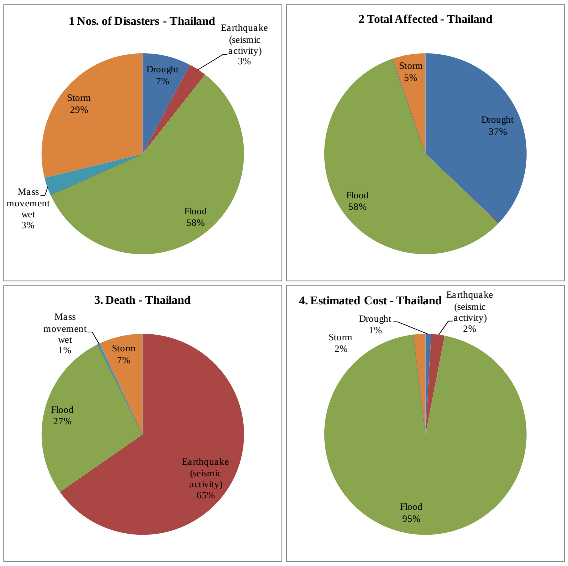
No particular disaster was reported for the past 32 years 1980–2011 in EM-DAT database.

Thailand:

Figure 2.5.7 shows that 58% of the number of disasters was caused by floods followed by storm (29%), while flood (58%) and drought (37%) are the two major disasters that affect the largest number of people. On the other hand, earthquake caused 65% of the total deaths that is because of the tsunami induced by the Sumatra Earthquake in 2004; flood caused 27% of the total deaths that largely attributes to the flood disaster of 2011. As for the estimated damage cost (economic loss), flood is the disaster that caused 95% of total economic losses, most of which was caused by the flood in 2011 that caused the loss of US$40 million.

<u>Vietnam</u>:

Figure 2.5.8 shows that storm and floods are the frequent disasters (storm: 52%, flood: 42% of the total number of disasters) in Vietnam that caused 92% of the total affected people (storm: 59%, flood: 33%), 98% of total deaths (storm: 68%, and flood: 30%), and 92% of estimated cost (storm: 50%, flood: 42%). Storm and flood are the most noteworthy disasters in Vietnam.

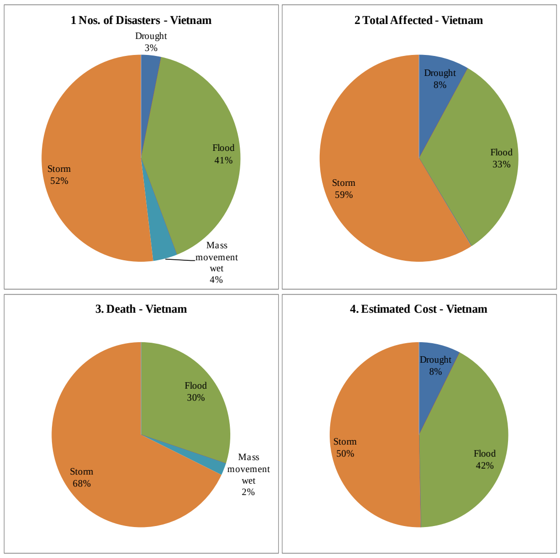


	Drought	Earthquake (seismic activity)	Flood	Mass movement dry	Mass movement wet	Storm	Volcano	Total
1 Nos. of Disasters - Thailand	8	3	60	0	3	30	0	104
2 Total Affected - Thailand	29,982,602	67,023	46,426,691	0	43,110	4,235,503	0	80,754,929
3. Death - Thailand	0	8,346	3,493	0	47	895	0	12,781
4. Estimated Cost - Thailand	424,300	1,000,000	44,355,408	0	0	892,039	0	46,671,747

Data from 1980 to 2011
Data Source: "EM-DAT: The OFDA/CRED International Disaster Database
www.emdat.be - Université Catholique de Louvain - Brussels - Belgium"
Presentation: JICA Study Team (2012)

Cost (x 1,000US$)

Figure 2.5.7
Outline of Natural Disasters in Thailand



	Drought	Earthquake (seismic activity)	Flood	Mass movement dry	Mass movement wet	Storm	Volcano	Total
1 Nos. of Disasters - Vietnam	5	0	63	0	6	80	0	154
2 Total Affected - Vietnam	6,110,000	0	24,717,019	0	39,074	44,060,402	0	74,926,495
3. Death - Vietnam	0	0	4,709	0	330	10,650	0	15,689
4. Estimated Cost - Vietnam	649,120	0	3,637,727	0	2,300	4,340,105	0	8,629,252

Data from 1980 to 2011
Data Source: "EM-DAT: The OFDA/CRED International Disaster Database
www.emdat.be - Université Catholique de Louvain - Brussels - Belgium"
Presentation: JICA Study Team (2012)

Cost (x 1,000US$)

Figure 2.5.8
Outline of Natural Disasters in Vietnam

2.6 Addendum-1 to Chapter 2: Data Set Utilized for the Descriptions

The data set for the period of 1980 – 2011 were used for the description of the disaster outline in ASEAN region in this Chapter 2; and are presented in the tables for further reference.

The data were downloaded from "EM-DAT: The OFDA/CRED International Disaster Database; www.emdat.be - Université Catholique de Louvain - Brussels - Belgium" in July 2012.

The followings are criteria for a disaster to be entered in the database and definitions for classification for damages. Please refer to the web-site indicated above, for further information.

CRITERIA AND DEFINITION

CRITERIA

For a disaster to be entered into the database, at least one of the following criteria must be fulfilled:

- Ten or more people reported killed.
- One hundred or more people reported affected.
- Declaration of a state of emergency.
- Call for international assistance.

DEFINITION

EM-DAT data include the main following information:

Country: Country (ies) in which the disaster has occurred.

Disaster type: Description of the disaster according to a pre-defined classification

Date: When the disaster occurred. The date is entered as follow: Month/Day/Year

Killed: Persons confirmed as dead and persons missing and presumed dead (official figures when available)

Injured: People suffering from physical injuries, trauma or illness, requiring medical treatment as a direct result of a disaster

Homeless: People needing immediate assistance for shelter

Affected: People requiring immediate assistance during a period of emergency; it can also include displaced or evacuated people

Total affected: Sum of injured, homeless, and affected

Estimated Damage: Several institutions have developed methodologies to quantify these losses in their specific domain. However, there is no standard procedure to determine a global figure for economic impact. Estimated damage are given (000') US$

(http://www.emdat.be/criteria-and-definition)

Table 2.6.1 Disaster Data Set of ASEAN Member States – Number of Disaster

No.	State	Drought	Earthquake (Ground Shaking)	Flood	Mass Movement (Wet)	Mass Movement (Dry)	Storm	Volcanic Eruption
1	Brunei	0	0	0	0	0	0	0
2	Cambodia	5	0	15	0	0	3	0
3	Indonesia	6	78	126	1	42	5	38
4	Lao	4	0	15	0	0	5	0
5	Malaysia	1	1	32	1	4	6	0
6	Myanmar	0	4	13	0	3	6	0
7	Philippines	7	13	109	3	27	209	16
8	Singapore	0	0	0	0	0	0	0
9	Thailand	8	3	60	0	3	30	0
10	Vietnam	5	0	63	0	6	80	0
	ASEAN	36	99	433	5	85	344	54

Data source: "EM-DAT: The OFDA/CRED International Disaster Database; www.emdat.be - Université Catholique de Louvain - Brussels - Belgium" in July 2012

Table 2.6.2 Disaster Data Set of ASEAN Member States– Total Number of Affected People

No.	State	Drought	Earthquake (Ground Shaking)	Flood	Mass Movement (Wet)	Mass Movement (Dry)	Storm	Volcanic Eruption
1	Brunei	0	0	0	0	0	0	0
2	Cambodia	6,550,000	0	11,173,637	0	0	178,091	0
3	Indonesia	1,083,000	8,438,429	7,290,138	701	392,967	14,638	772,966
4	Lao	750,000	0	3,259,740	0	0	1,436,199	0
5	Malaysia	5,000	5,063	566,058	0	291	47,946	0
6	Myanmar	0	37,137	850,112	0	146,367	2,866,125	0
7	Philippines	6,549,542	1,979,293	15,414,285	0	317,516	103,563,950	1,585,713
8	Singapore	0	0	0	0	0	0	0
9	Thailand	29,982,602	67,023	46,426,691	0	43,110	4,235,503	0
10	Vietnam	6,110,000	0	24,717,019	0	39,074	44,060,402	0
	ASEAN	51,030,144	10,526,945	109,697,680	701	939,325	156,402,854	2,358,679

Data source: "EM-DAT: The OFDA/CRED International Disaster Database; www.emdat.be - Université Catholique de Louvain - Brussels - Belgium" in July 2012

Table 2.6.3 Disaster Data Set of ASEAN Member States – Total Number of Deaths

No.	State	Drought	Earthquake (Ground Shaking)	Flood	Mass Movement (Wet)	Mass Movement (Dry)	Storm	Volcanic Eruption
1	Brunei	0	0	0	0	0	0	0
2	Cambodia	0	0	1,382	0	0	44	0
3	Indonesia	1,266	179,378	5,382	131	1,757	6	690
4	Lao	0	0	135	0	0	72	0
5	Malaysia	0	80	196	72	96	275	0
6	Myanmar	0	145	422	0	109	138,709	0
7	Philippines	8	2,540	2,396	361	2,304	26,055	719
8	Singapore	0	0	0	0	0	0	0
9	Thailand	0	8,346	3,493	0	47	895	0
10	Vietnam	0	0	4,709	0	330	10,650	0
	ASEAN	1,274	190,489	18,115	564	4,643	176,706	1,409

Data source: "EM-DAT: The OFDA/CRED International Disaster Database; www.emdat.be - Université Catholique de Louvain - Brussels - Belgium" in July 2012

Table 2.6.4 Disaster Data Set of ASEAN Member States – Estimated Cost (x US$1,000)

No.	State	Drought	Earthquake (Ground Shaking)	Flood	Mass Movement (Wet)	Mass Movement (Dry)	Storm	Volcanic Eruption
1	Brunei	0	0	0	0	0	0	0
2	Cambodia	138,000	0	919,100	0	0	10	0
3	Indonesia	89,000	11,349,576	2,452,016	1,000	120,745	0	344,190
4	Lao	1,000	0	22,828	0	0	405,951	0
5	Malaysia	0	500,000	1,012,500	0	0	53,000	0
6	Myanmar	0	503,600	136,655	0	0	4,067,688	0
7	Philippines	64,453	380,025	1,234,883	0	33,281	6,265,657	216,282
8	Singapore	0	0	0	0	0	0	0
9	Thailand	424,300	1,000,000	44,355,408	0	0	892,039	0
10	Vietnam	649,120	0	3,637,727	0	2,300	4,340,105	0
	ASEAN	1,365,873	13,733,201	53,771,117	1,000	156,326	16,024,450	560,472

Data source: "EM-DAT: The OFDA/CRED International Disaster Database; www.emdat.be - Université Catholique de Louvain - Brussels - Belgium" in July 2012

2.7 Addendum-2 to Chapter-2: ASEAN Hazard Profile – An Analysis with Recent Major Natural Disasters Excluded

Descriptions from sub-chapter 2.1 to sub-chapter 2.5were made through an analysis with all data downloaded from EM-DAT to avoid arbitrariness or specific intensions. As a result, the data of major natural disasters such as of the Cyclone Nargis or the 2004 Sumatra Earthquake were highly noticeable in particular counties or for the cases of particular disasters. At the same time, the data of the major disasters have masked the effects of frequent and problematic disasters. In order to understand the effects of such frequent and problematic disasters, an analysis was made with the data that excluded the data of the recent major natural disasters from the data during the period of 1980 – 2011 downloaded from EM-DAT. The data excluded are shown in the tables below[4].

Table 2.7.1 The Data Excluded from the Analysis

Total Affected	Sumatra EQ 2004	Nargis 2008	Ondoi/Ketsana 2009	Thai flood 2011
Cambodia			178,091	
Indonesia	673,731			
Lao PDR			128,887	
Malaysia	5,063			
Myanmar	15,700	2,420,000		
Philippines			12,221,663	
Thailand	67,007			10,216,110
Vietnam			2,977,460	
Total	761,501	2,420,000	15,506,101	10,216,110

Death	Sumatra EQ 2004	Nargis 2008	Ondoi/Ketsana 2009	Thai flood 2011
Cambodia			19	
Indonesia	165,816			
Lao PDR			16	
Malaysia	80			
Myanmar	71	138,366		
Philippines			1,242	
Thailand	8,345			877
Vietnam			306	
Total	174,312	138,366	1,583	877

million USD

Estmated Cost	Sumatra EQ 2004	Nargis 2008	Ondoi/Ketsana 2009	Thai flood 2011
Cambodia				
Indonesia	4,519,600			
Lao PDR			100,000	
Malaysia	500,000			
Myanmar	500,000	4,000,000		
Philippines			932,703	
Thailand	1,000,000			40,317,000
Vietnam			1,065,200	
Total	6,519,600	4,000,000	2,097,903	40,317,000

Data Source：data from ED-DAT sorted out with the following conditions:
Sumatra Earthquake: year 2004, earthquake, ASEAN countries,
Cyclone Nargis: year 2008, storm. Myanmar,
Ondoi/Ketsana: year 2009, storm, ASEAN countries
Chao Phraya River Flood: year 2011, flood, Thailand

[4] For further analysis the readers are encouraged to visit the HP of EM-DAT

2.7.1 Natural Hazard in ASEAN Region – for a Case with Data Excluding the Data of the Recent Major Natural Disasters

<u>Total Number of People Affected</u>

Figure 2.7.1 shows “Total Number of People Affected” and “Total Affected per Event”.

Figure 2.7.1 represents a similar distribution pattern before and after the data exclusion (see also Figure 2.2.2). This is because that total people affected during the period of 1980 – 2011 are extremely larger than those of the recent major disasters.

<u>Total Number of Death</u>

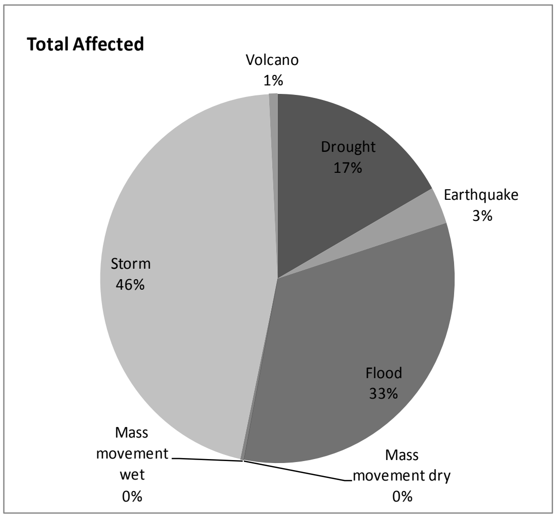
Figure 2.7.2 shows “Total Number of Death” and “Total Number of Death per Event”.

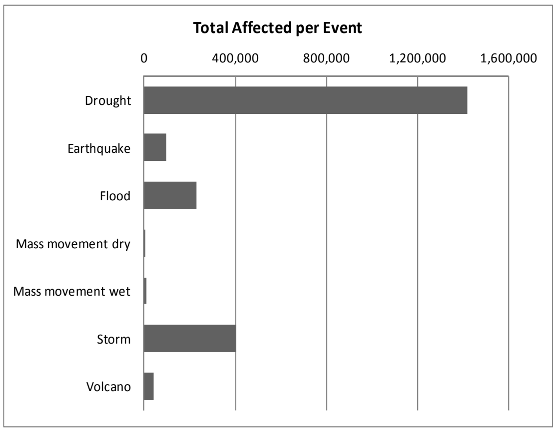
As compared with Figure 2.2.3 before the data exclusion, the death by earthquake decreased (49% →21%), while the death by flood (5% →22%) and sediment disasters (1%→7%) increased. The storm is still a major cause of death (45%→47%) even after the data exclusions.

After exclusion of data (2004 Sumatra Earthquake), the death from earthquake (per event) decreased (1,924 →163) drastically, while death from mass movement-dry (113) is revealed as large as the one from storm (107).

<u>Estimated Cost</u>

Figure 2.7.3 shows “Estimated Cost” and “Estimated Cost per Event”.



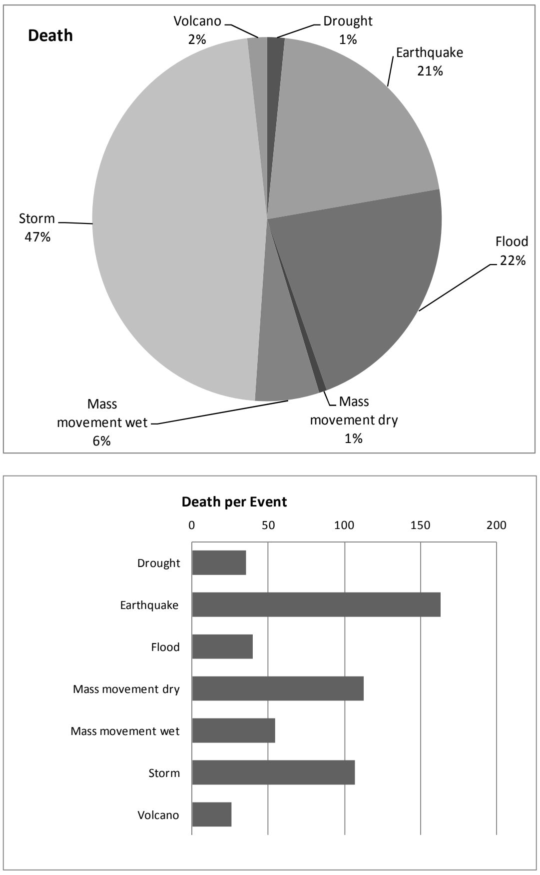


Total Affected	Total Affected	%	Nos of Disasters	Total Affected per event
Drought	51,030,144	15.4%	36	1,417,504
Earthquake	9,765,444	3.2%	99	98,641
Flood	99,481,570	33.1%	433	229,750
Mass movement dry	701	0.0%	5	140
Mass movement wet	939,325	0.3%	85	11,051
Storm	138,476,753	47.3%	344	402,549
Volcano	2,358,679	0.7%	54	43,679
Total	302,052,616	100%	1,056	2,203,313

Data from 1980 to 2011
Data Source: "EM-DAT: The OFDA/CRED International Disaster Database
www.emdat.be - Université Catholique de Louvain - Brussels - Belgium"
Presentation: JICA Study Team (2012)

Figure 2.7.1 Total Number of People Affected - for a Case with Data Excluding the Recent Major Disasters

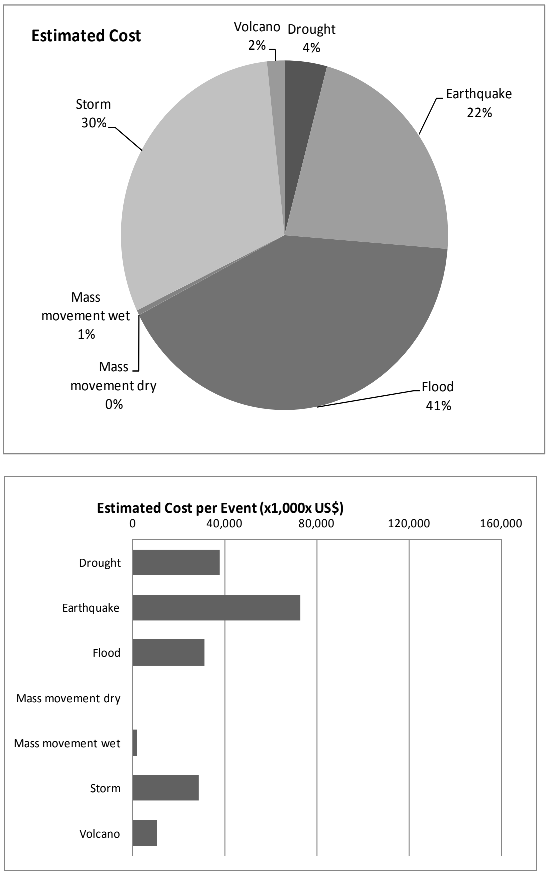
As compared with data before the data exclusion (Figure 2.2.4), Cost (damage) by flood decreased (65% → 41%); while the cost of storm (19% →30%) and earthquake (16% →22%) increased. This is due to the exclusion of the data of 2011 Chao Phraya River flood in Thailand. In any case, those three disasters are the major disasters in ASEAN region. Similarly, damage (cost) by flood was as large as the damage by earthquake before data exclusion (see also Figure 2.2.4), the damage by flood decreased to a similar levels of the damage of draught and flood, while the damage by earthquake remained largest though the 2004 Sumatra earthquake was also excluded. The damage by the Chao Phraya River flood was far larger than the damage of the 2004 Sumatra earthquake.



Death	Death	%	Nos of Disasters	Death per event
Drought	1,274	1.6%	36	35
Earthquake	16,177	20.7%	99	163
Flood	17,238	22.1%	433	40
Mass movement dry	564	0.7%	5	113
Mass movement wet	4,643	5.9%	85	55
Storm	36,757	47.1%	344	107
Volcano	1,409	1.8%	54	26
Total	78,062	100%	1,056	539

Data from 1980 to 2011
Data Source: "EM-DAT: The OFDA/CRED International Disaster Database
www.emdat.be - Université Catholique de Louvain - Brussels - Belgium"
Presentation: JICA Study Team (2012)

Figure 2.7.2 Total Number of Death for a Case with Data Excluding the Recent Major Disasters



Estimated Cost	Estimated Cost	%	Nos of Disasters	Estimated Cost per event (x 1,000US$)
Drought	1,365,873	4.2%	36	37,941
Earthquake	7,213,601	22.1%	99	72,865
Flood	13,454,117	41.2%	433	31,072
Mass movement dry	1,000	0.0%	5	200
Mass movement wet	156,326	0.5%	85	1,839
Storm	9,926,547	30.4%	344	28,856
Volcano	560,472	1.7%	54	10,379
Total	32,677,936	1	1,056	183,152

Data from 1980 to 2011
Data Source: "EM-DAT: The OFDA/CRED International Disaster Database
www.emdat.be - Université Catholique de Louvain - Brussels - Belgium"
Presentation: JICA Study Team (2012)

Figure 2.7.3 Estimated Cost for a Case with Data Excluding the Recent Major Disasters

2.7.2 Disaster Prone States in the ASEAN Regions- For A Case with Data Excluding the Data of the Recent Major Natural Disasters

Figure 2.7.4 shows “Number of Total People Affected”, “Number of Death” and “Estimated Cost”.

<u>Number of Total People Affected by State</u>

As compared with the data before the data exclusion, the distributions of the number of total people affected are similar. Still, the Philippines is largest in number of affected followed by

Thailand and Vietnam. Those three states are very susceptible to the disaster by storm and flood as to be explained later part of this chapter.

Number of Death by State

Before the data exclusion, Indonesia is the largest and Myanmar is the second in the number of total death (Figure 2.3.3) due to the huge number of causality from 2004 Sumatra Earthquake and 2008 Cyclone Nargis, while after the data exclusion the Philippines is the largest followed by Indonesia and Vietnam. In those three states, death form storm and flood prevails; in addition to those two disasters, earthquake is the other major cause of the death in Indonesia as to be explained in later part of this chapter.

Estimated Cost of Damage by State

Before the data exclusion, the estimated cost of Thailand was far bigger than those of others (Figure 2.3.4); while Indonesia is the largest followed by Vietnam and the Philippines after the data exclusion. This is due to the damage by the Cho Phraya River flood that caused unprecedentedly huge damages. Similar to the case of "death" after the data exclusion, storm and flood are the major causes of the damage in the four states (Indonesia, the Philippines, Thailand and Vietnam); earthquake is the other major cause of the damage in Indonesia.

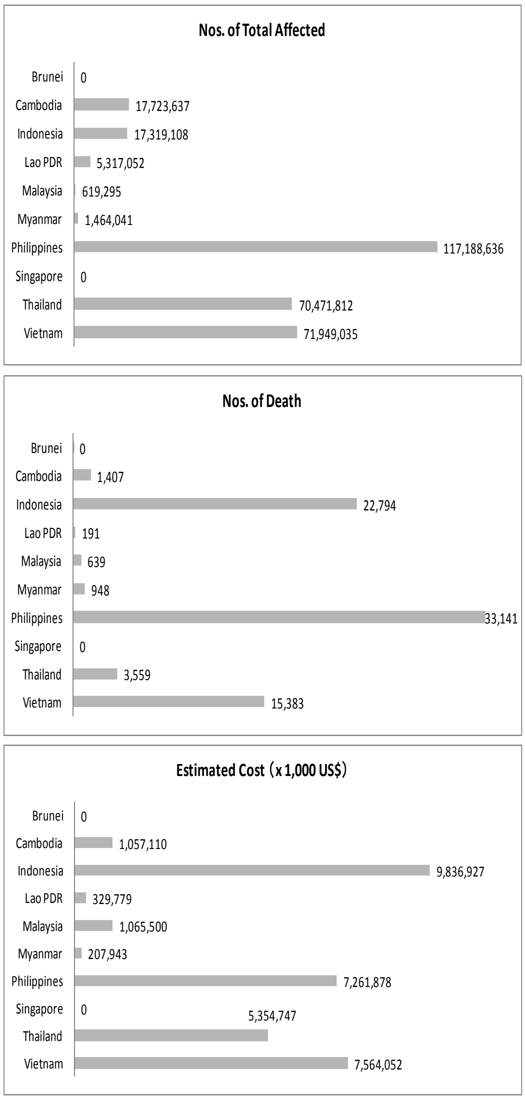


Figure 2.7.4 Total Affected, Death and Estimated Cost (damage) - for a Case with Data Excluding the Recent Major Disasters

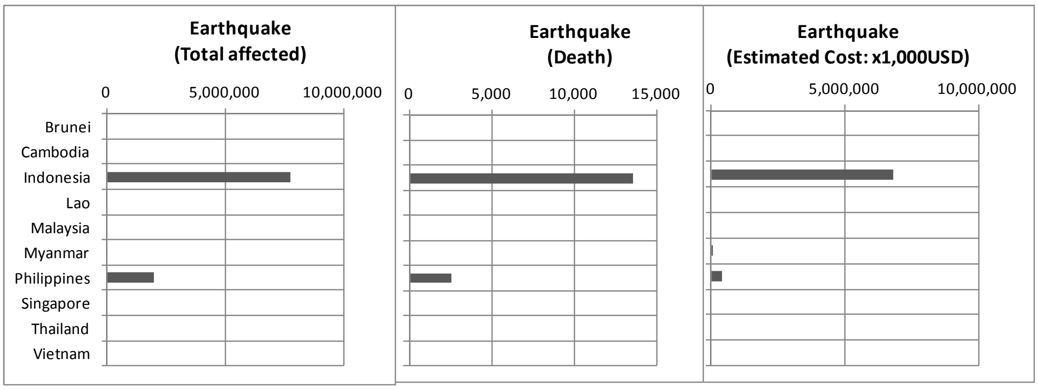
2.7.3 Natural Disasters of ASESN States According to Hazard – for a Case with Data Excluding the Data of the Recent Major Natural Disasters

Drought

The data regarding drought was not excluded for this analysis. Refer to Sub-Chapter 2.4 of this report for the description of drought.

Earth Quake

Figure 2.7.5 shows the disaster indicators (Total people affected Death and Estimated cost) according to earthquake for the case with data excluding the recent major natural disaster (2004 Sumatra earthquake for the case of earthquake). Even after the exclusion of the data of 2004 Sumatra Earthquake, Indonesia is the state that has been most suffered from earthquakes among the ASEAN states, followed by the Philippines.

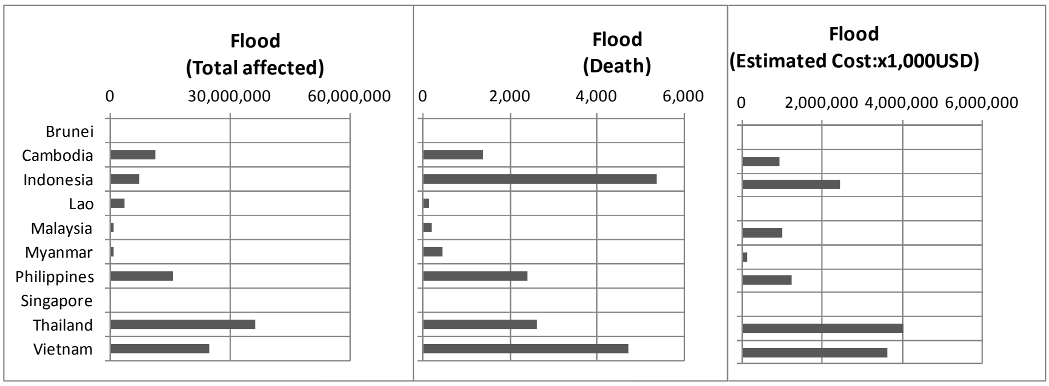


Data from 1980 to 2011
Data Source: "EM-DAT: The OFDA/CRED International Disaster Database
www.emdat.be - Université Catholique de Louvain - Brussels - Belgium"
Presentation: JICA Study Team (2012)

Figure 2.7.5 Natural Disaster Indicators according to Earthquake – for the Case with Data Excluding the Recent Major Natural Disasters

<u>Flood</u>

Figuer 2.7.6 shows the disaster indicatores for the case with the data excluding the data of the recent major natural disasters: data of 2011 Cho Phraya River Flood for the case of flood. Before the data exclusion, Thaikand was the largest in estimaged cost (Figure 2.4.6); while Indonesia, the Philippiens, Thailand and Vietnam are understood to be largely suffered from flood after the data exclusing. It is noted that death from flood in Indonesia and Vienam exceeded 4,000 for the peiod of 1980 -2011.



Data from 1980 to 2011
Data Source: "EM-DAT: The OFDA/CRED International Disaster Database
www.emdat.be - Université Catholique de Louvain - Brussels - Belgium"
Presentation: JICA Study Team (2012)

Figure 2.7.6 Disaster Indicators by State according to Flood – for the Case with the Data Excluding the Data of the Recent Major Natural Disasters

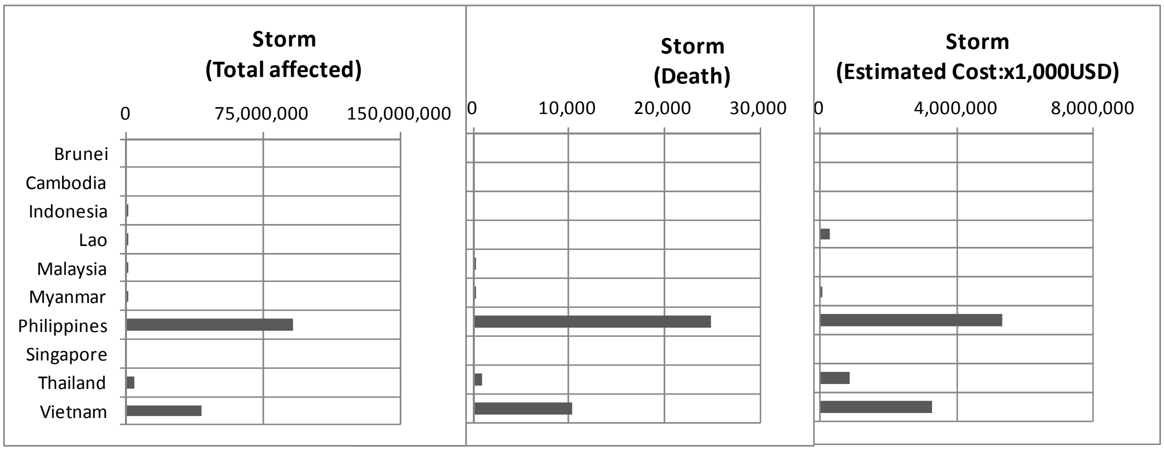
<u>Sediment Disasters/Mass Movement</u>

The data regarding sediment disasters/ mass movement was not excluded for this analysis. Refer to Sub-Chapter 2.4 of this report for the description of this disaster.

Storm

Figure 2.7.7 shows the natural disaster indicators with the data excluding the recent major natural disasters (2008 Cyclone Nargis, and 2009 Typhoon Ondoi/Ketsana for the case of storm).

No major storms were recorded in Myanmar after the data exclusion of Cyclone Nargis; while the Philippine and Vietnam are major states that were suffered from storms even after the data exclusion of the Typhoon Ondoi/Ketsana that caused huge damages in the Philippines and Vietnam. The Philippines and Vietnam are an region where typhoons hit frequently. Lao PDR and Thailand



Data from 1980 to 2011
Data Source: "EM-DAT: The OFDA/CRED International Disaster Database
www.emdat.be - Université Catholique de Louvain - Brussels - Belgium"
Presentation: JICA Study Team (2012)

Figure 2.7.7 The Natural Disaster Indicators by State according to Storm – for the Case with the Data excluding the Data of the Recent Manor Natural Disasters

Volcano

The data regarding volcano disasters was not excluded for this analysis. Refer to Sub-Chapter 2.4 of this report for the description of this disaster.

2.7.4 Natural Disaster Indicators in Member State – For the Case with The Data Excluding the Data of the Recent Major Natural Disasters

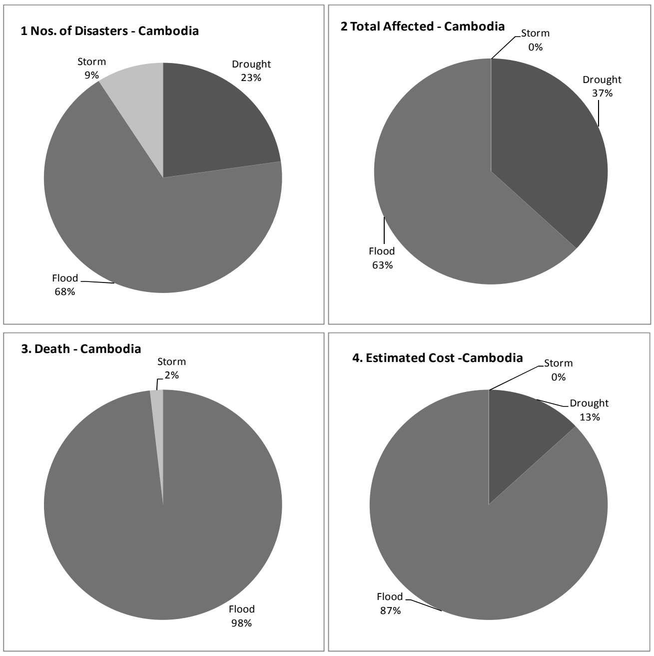
Since no disasters have been recorded in EM-DAT form Brunei and Singapore, this sub-chapter excludes those two states for description.

Cambodia

Figure 2.7.8 shows the natural disaster indicators of Cambodia after the data exclusion (data of 2009 Typhoon Ondoi/Ketsana for the case of Cambodia). As compared with the data before the data exclusion (Figure 2.5.1), the distribution patterns of the indicators are similar even after the data exclusion. The disasters from storm has not been so serious compared with drought or flood in Cambodia during the period of 1980 – 2011.

Indonesia

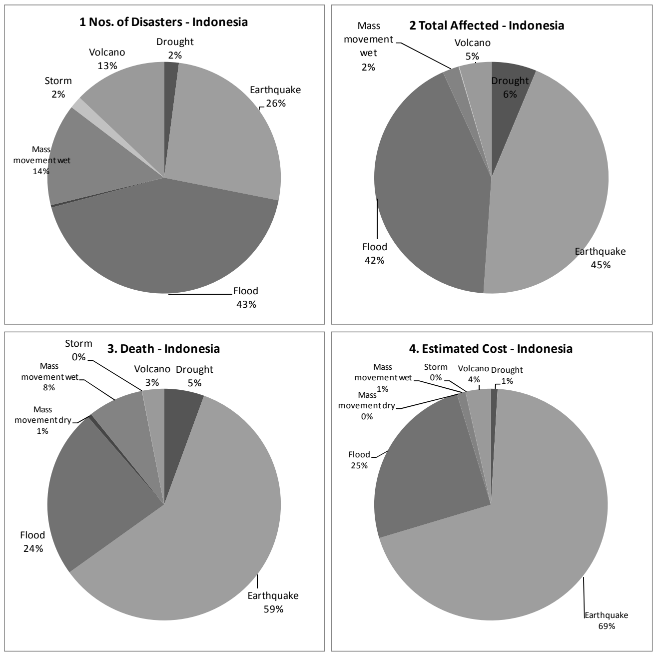
Figure 2.7.9 shows the natural disaster indicators of Indonesia after the data exclusion (data of 2004 Sumatra Earthquake was excluded for the case of Indonesia). After the data exclusion the percentage of death decreased remarkably (93% → 59%); and there are reductions of total people affected (47% → 45%) and estimated cost (79% → 69%) as compared with the data before the data exclusion (Figure 2.5.2). Figure 2.7.9 has revealed that flood (42% of total affected people, 24% of the total death and 25% of the estimated cost) is also the major natural disaster in Indonesia, while earthquake is still the most serious disaster in Indonesia.



	Drought	Earthquake	Flood	Mass movement dry	Mass movement wet	Storm	Volcano	Total
1 Nos. of Disasters - Cambodia	5	0	15	0	0	2	0	22
2 Total Affected - Cambodia	6,550,000	0	11,173,637	0	0	0	0	17,723,637
3. Death - Cambodia	0	0	1,382	0	0	25	0	1,407
4. Estimated Cost -Cambodia	138,000	0	919,100	0	0	10	0	1,057,110

Hazard from 1980 to 2011
Estimated Cost (x1,000US$)
Source: "EM-DAT: The OFDA/CRED International Disaster Database
www.emdat.be - Université Catholique de Louvain - Brussels - Belgium"
Presentation: JICA Study Team (2012)

Figure 2.7.8 Natural Disaster Indicators of Cambodia - for the case with data excluding the recent major natural disasters



	Drought	Earthquake	Flood	Mass movement dry	Mass movement wet	Storm	Volcano	Total
1 Nos. of Disasters - Indonesia	6	77	126	1	42	5	38	295
2 Total Affected - Indonesia	1,083,000	7,764,698	7,290,138	701	392,967	14,638	772,966	17,319,108
3. Death - Indonesia	1,266	13,562	5,382	131	1,757	6	690	22,794
4. Estimated Cost - Indonesia	89,000	6,829,976	2,452,016	1,000	120,745	0	344,190	9,836,927

Hazard from 1980 to 2011
Estimated Cost (x1,000US$)
Source: "EM-DAT: The OFDA/CRED International Disaster Database
www.emdat.be - Université Catholique de Louvain - Brussels - Belgium"
Presentation: JICA Study Team (2012)

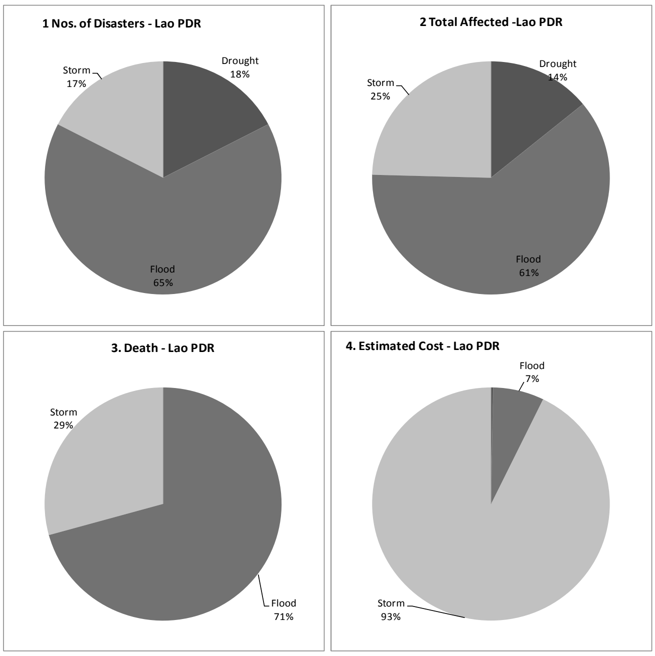
Figure 2.7.9 Natural Disaster Indicators of Indonesia – for the case with data excluding the recent major natural disasters

Lao PDR

Figure 2.7.10 shows the natural disaster indicators with the data excluding the data of the recent major natural disasters (2009 Typhoon Ondoi/Ketsana for the case of Lao PDR). No remarkable changes are observed between the two figures before/after the data exclusion (Figure 2.5.3). Lao PDR is characterized by the observation that flood prevails for the total affected people and death, while storm prevails in the estimated cost.

Malaysia

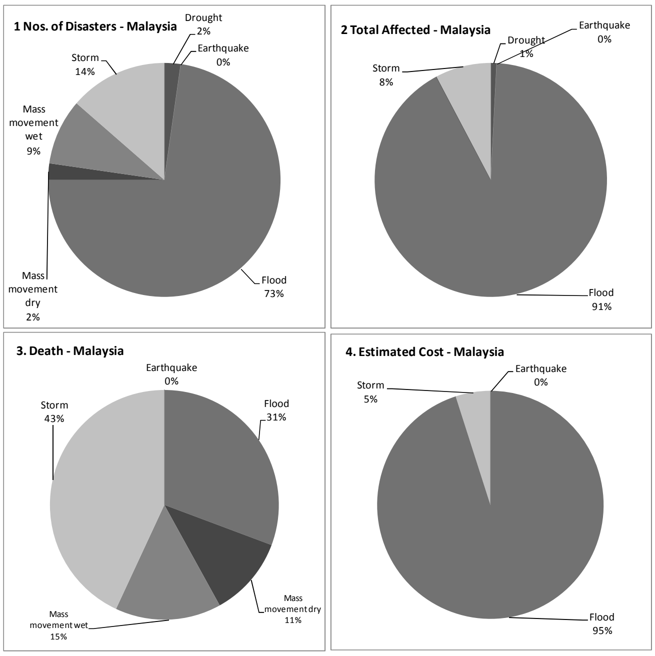
Figure 2.7.11 shows the natural disaster indicators with the data excluding the data of the recent major natural disasters (2004 Sumatra earthquake was excluded for the case of Malaysia). The Sumatra earthquake was the only one earthquake disaster in Malaysia durog the period of 1980 – 2011. As the result, after the data exclusion, the death from earthquake (80 persons) and the damage cost (500,000 US$) turned to be nil as 11% → 0% and 32% → 0% respectively (see also Figure 2.5.4). Flood is the major disaster in terms of total affected people (90% →91%) and estimated cost (65% → 9%), while deaths were caused various types of hazard including storm (27% → 31%) and sediment disasters (24% →26%).



	Drought	Earthquake	Flood	Mass movement dry	Mass movement wet	Storm	Volcano	Total
1 Nos. of Disasters - Lao PDR	4	0	15	0	0	4	0	23
2 Total Affected -Lao PDR	750,000	0	3,259,740	0	0	1,307,312	0	5,317,052
3. Death - Lao PDR	0	0	135	0	0	56	0	191
4. Estimated Cost - Lao PDR	1,000	0	22,828	0	0	305,951	0	329,779

Hazard from 1980 to 2011 Estimated Cost (x1,000US$)
Source: "EM-DAT: The OFDA/CRED International Disaster Database
www.emdat.be - Université Catholique de Louvain - Brussels -
Presentation: JICA Study Team (2012)

Figure 2.7.10 Natural Disaster Indicators in Lao PDR – for the case with the data excluding the recent major natural disasters



	Drought	Earthquake	Flood	Mass movement dry	Mass movement wet	Storm	Volcano	Total
1 Nos. of Disasters - Malaysia	1	0	32	1	4	6	0	44
2 Total Affected - Malaysia	5,000	0	566,058	0	291	47,946	0	619,295
3. Death - Malaysia	0	0	196	72	96	275	0	639
4. Estimated Cost - Malaysia	0	0	1,012,500	0	0	53,000	0	1,065,500

Hazard from 1980 to 2011 Estimated Cost (x1,000US$)
Source: "EM-DAT: The OFDA/CRED International Disaster Database
www.emdat.be - Université Catholique de Louvain - Brussels - Belgium"
Presentation: JICA Study Team (2012)

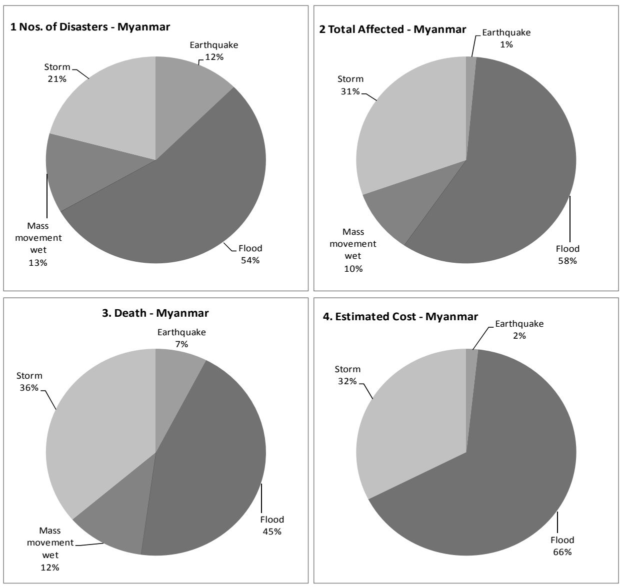
Figure 2.7.11 Natural Disaster Indicators in Malaysia - for the case with the data excluding the recent major natural disasters

<u>Myanmar</u>

Figure 2.7.12 shows the natural disaster indicators after the data exclusion (2008 Cyclone Nargis was excluded for the case of Myanmar). Disasters from storm including the Nargis occupied a considerable part of the total disasters during the period of 1980-2012 (see Figure 2.5.5); while after the data exclusion, the part remarkably decreased as total affected people (71% → 31%), total death (100% → 36%) and estimated damage cost (86% → 32%). Instead, flood tool the major part of the disaster as total people affected (22% → 58%), death (0% → 45%) and estimated damage cost (3% → 66%). It is observed that flood and storm are the two major disasters in Myanmar. In addition, sediment disaster shows about 10 % in total people affected or in death, which may have to be drawn attentions.

<u>Philippines</u>

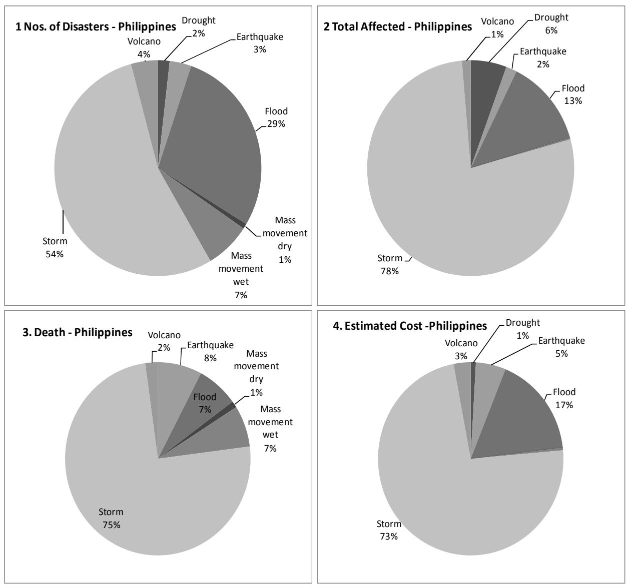
Figure 2.7.13 shows the natural disaster indicators after the data exclusion (2009 Typhoon Ondoi/Ketsana was excluded for the case of the Philippines). The typhoon caused considerably huge damages in Philippines (12 million total affected people, 1,200 death and estimated damage of 933 thousand US$), which corresponded 13 % of the total damage from storms during the period of 1980 – 2011. However, the distribution patterns of the indicators showed no meaningful change before and after the data exclusion; this is because the damages caused by storm were overwhelmingly larger than the cases of the other disasters and the accumulated storm disasters were also far bigger than the disasters by the Typhoon Ondoi/Ketsana (also see Figure 2.5.6).



	Drought	Earthquake	Flood	Mass movement dry	Mass movement wet	Storm	Volcano	Total
1 Nos. of Disasters - Myanmar	0	3	13	0	3	5	0	24
2 Total Affected - Myanmar	0	21,437	850,112	0	146,367	446,125	0	1,464,041
3. Death - Myanmar	0	71	422	0	109	343	0	945
4. Estimated Cost - Myanmar	0	3,600	136,655	0	0	67,688	0	207,943

Hazard from 1980 to 2011
Estimated Cost (x1,000US$)
Source: "EM-DAT: The OFDA/CRED International Disaster Database
www.emdat.be - Université Catholique de Louvain - Brussels - Belgium"
Presentation: JICA Study Team (2012)

Figure 2.7.12 Natural Disaster Indicators of Myanmar – for the case with the data excluding the recent major natural disasters



	Drought	Earthquake	Flood	Mass movement dry	Mass movement wet	Storm	Volcano	Total
1 Nos. of Disasters - Philippines	7	13	109	3	27	208	16	383
2 Total Affected - Philippines	6,549,542	1,979,293	15,414,285	0	317,516	91,342,287	1,585,713	117,188,636
3. Death - Philippines	8	2,540	2,396	361	2,304	24,813	719	33,141
4. Estimated Cost -Philippines	64,453	380,025	1,234,883	0	33,281	5,332,954	216,282	7,261,878

Hazard from 1980 to 2011
Estimated Cost (x1,000US$)
Source: "EM-DAT: The OFDA/CRED International Disaster Database
www.emdat.be - Université Catholique de Louvain - Brussels - Belgium"
Presentation: JICA Study Team (2012)

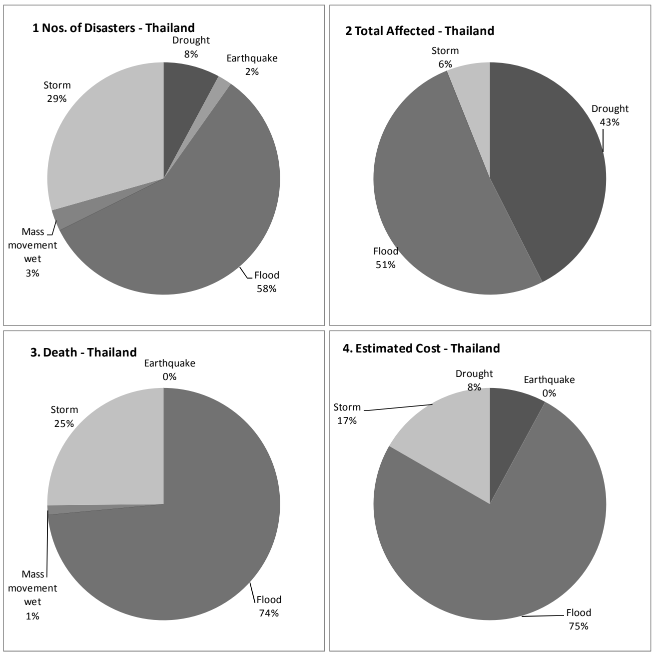
Figure 2.7.13 Natural Disaster Indicators of Philippines – for the case with the data excluding the recent major natural disasters

Thailand

Figure 2.7.14 shows the natural disaster indicators after the data exclusion (the data of 2004 Sumatra earthquake and 2011 Chao Phraya river flood were excluded for the case of Thailand). After the data exclusion, the death from earthquake reduced drastically (8,346 →1 person; 65% → 0%), which implies the 2004 Sumatra earthquake was the extraordinary event of earthquake. Other than the case of the earthquake, the distribution pattern of the disaster indicators are similar before and after the data extraction (see also Figure 2.5.7), though a decrease of percentage is observed for flood (95% →75%) due to the data exclusion of the Chao Phraya river flood. Flood and storm are the major causes of disasters in Thailand.

Vietnam

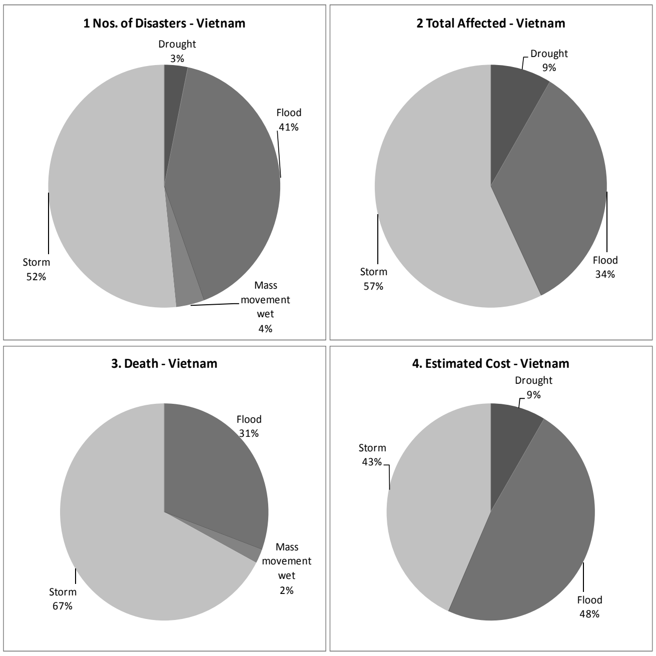
Figure 2.7.15 shows the natural disaster indicators after the data exclusion (the data of 2009 Typhoon Ondoi/Ketsana was excluded for the case of Vietnam). Though the Typhoon caused a considerably huge damage to Vietnam (three million of the total affected people, 300 death and one million of estimated damage cost), the distribution patterns of the disaster indicators before and after the data exclusion are similar (see also Figure 2.5.8). Flood and storm are the major causes of disasters in Vietnam.



	Drought	Earthquake	Flood	Mass movement dry	Mass movement wet	Storm	Volcano	Total
1 Nos. of Disasters - Thailand	8	2	59	0	3	30	0	102
2 Total Affected - Thailand	29,982,602	16	36,210,581	0	43,110	4,235,503	0	70,471,812
3. Death - Thailand	0	1	2,616	0	47	895	0	3,559
4. Estimated Cost - Thailand	424,300	0	4,038,408	0	0	892,039	0	5,354,747

Hazard from 1980 to 2011
Estimated Cost (x1,000US$)
Source: "EM-DAT: The OFDA/CRED International Disaster Database
www.emdat.be - Université Catholique de Louvain - Brussels - Belgium"
Presentation: JICA Study Team (2012)

Figure 2.7.14 Natural Disaster Indicators of Thailand – for the case with the data excluding the recent major natural disasters



	Drought	Earthquake	Flood	Mass movement dry	Mass movement wet	Storm	Volcano	Total
1 Nos. of Disasters - Vietnam	5	0	63	0	6	79	0	153
2 Total Affected - Vietnam	6,110,000	0	24,717,019	0	39,074	41,082,942	0	71,949,035
3. Death - Vietnam	0	0	4,709	0	330	10,344	0	15,383
4. Estimated Cost - Vietnam	649,120	0	3,637,727	0	2,300	3,274,905	0	7,564,052

Hazard from 1980 to 2011
Estimated Cost (x1,000US$)
Source: "EM-DAT: The OFDA/CRED International Disaster Database
www.emdat.be - Université Catholique de Louvain - Brussels - Belgium"
Presentation: JICA Study Team (2012)

Figure 2.7.15 Natural Disaster Indicators of Vietnam – for the case with the data excluding the recent major natural disasters

CHAPTER 3 INVENTORY SURVEY

3.1 Inventory of Disaster Management Information by Country

Inventories of information related to disaster management of ASEAN countries have been prepared by the JICA Head Office in Tokyo as part of its knowledge management. The items of inventory updated in 2010 basically consist of the following; 1) Characteristics of Disasters, 2) Administrative Structure, 3) Disaster Mitigation/Preparedness, 4) Emergency Response, 5) Community Based Disaster Management, 6) Climate Change and Adaptation, and others. The Study Team updated the inventory with the information collected through this data collection survey.

The summary inventory of each member state is attached to this report. The detailed inventories were also prepared in a separate volume **(**Appendix-6).

3.2 Information Items of Inventory

The inventories will be helpful in understanding the progress of disaster management of the member states. This will facilitate future regional cooperation and/or collaboration in disaster management of concerned organizations that would like to consider.

There are two frameworks to be considered when monitoring the progress of ASEAN members, i.e., 1) Hyogo Framework for Action 2010-2015 and 2) AADMER Work Program 2010-2015.

3.2.1 Hyogo Framework for Action 2005-2015

(1) Five Priorities for Action

The World Conference on Disaster Reduction was held in January 2005 in Kobe, Hyogo, Japan. The conference adopted the "Hyogo Framework for Action (HFA) 2005-2015: Building the Resilience of Nationals and Communities to Disasters". The conference provided a unique opportunity to promote a strategic and systematic approach to reduce vulnerability and risks to hazards. It underscores the need for, and identified ways of building the resilience of nations and communities toward disaster. The 2005 conference adopted the following priorities for action for disaster risk reduction[1]:

1) Ensure that disaster risk reduction is a national and local priority with a strong institutional basis for implementation (HFA-1).
2) Identify, access, and monitor disaster risks and enhance early warning (HFA-2).
3) Use knowledge, innovation, and education to build a culture of safety and resilience at all levels (HFA-3).
4) Reduce the underlying risk factors (HFA-4).
5) Strengthen disaster preparedness for effective response at all levels (HFA-5).

[1] The text largely refers to Hyogo Framework or Action 2005-2015; ISDR

Under each of these five priorities, key activities are listed for different states, regional and international organizations and other actors concerned to take into consideration in adopting them, as appropriate, into their own circumstances and capacities. The key activities are shown in Table 3.2.1 below.

Table 3.2.1 HFA Five Priority Actions and their Key Activities; and Indicators of Progress

Five Priority Actions		Key Activities	Indicators of Progress
HFA-1	Ensure that disaster risk reduction is a national and local priority with strong institutional basis for implementation	(i) National institutional and legislative frameworks	(i) National institutional and legal frameworks for disaster risk reduction exist with decentralized responsibilities and capacities at all levels.
		(ii) Resources	(ii) Dedicated and adequate resources are available to implement disaster risk reduction plans at all administrative levels.
		(iii) Community participation	(iii) Community participation and decentralization are ensured through the delegation of authority and resources at all local levels.
			(iv) A national multi-sectoral platform for disaster risk reduction is functioning.
HFA-2	Identify, assess, and monitor risk and enhance early warning	(i) National and local risk assessments	(i) National and local risk assessments based on hazard data and vulnerability information are available and include risk assessments for the key sectors.
		-	(ii) Systems are in place to monitor, archive, and disseminate data on key hazards and vulnerabilities.
		(ii) Early warning	(iii) Early warning systems are in place for all major hazards, with outreach to communities.
		(iii) Capacity	-
		(iv) Regional and emerging risks	(iv) National and local risk assessments take into account the regional/transboundary risks, in view of the regional cooperation on risk reduction.
HFA-3	Use knowledge, innovation, and education to build a culture of safety and resilience at all levels	(i) Information management and exchange	(i) Relevant information on disasters is available and accessible to all levels, to all stakeholders (through networks, development of information sharing system)
		(ii) Education and training	(ii) School curricula, education material, and relevant trainings include risk reduction and recovery concepts and practices.
		(iii) Research	(iii) Research methods and tools for multi-risk assessments and cost-benefit analysis are developed and strengthened.
		(iv) Public awareness	(iv) Country wide public awareness strategy exists to stimulate a culture of disaster resilience, with outreach to urban and rural communities.
HFA-4	Reduce the underlying risk factors	(i) Environmental and natural resource management	(i) Disaster risk reduction is an integral objective of environment-related policies and plans including land use, natural resource management, and climate change adaptation.
		(ii) Social and economic development practices	(ii) Social development policies and plans are being implemented to reduce the vulnerability of population most at risk.
			(iii) Economic and productive sectoral policies and plans have been implemented to reduce the vulnerability of economic activities.
		(iii) Land-use planning and other technical measures	(iv) Planning and management of human settlements incorporated with disaster risk reduction elements including enforcement of building codes.
			(v) Disaster risk reduction measures are integrated into post-disaster recovery and rehabilitation processes.
			(vi) Procedures are in place to assess disaster risk impacts to all major development projects, especially on the infrastructure.
HFA-5	Strengthen disaster preparedness	-	(i) Strong policy, technical and institutional capacities and mechanisms for disaster management, with disaster risk reduction perspective are in place.
			(ii) Disaster preparedness plans and contingency plans are in place at all administrative levels, and regular training drills and rehearsals are held to test and develop disaster response programs.
			(iii) Financial reserves and contingency mechanisms are in place to enable effective response and recovery when required.
			(iv) Procedures are in place to exchange relevant information during disasters and to undertake post-event reviews.

Source: Hyogo Framework for Action 2005–2015 (ISDR), Indicators of Progress (ISDR) combined by the JICA Study Team (2012)

(2) Indicator of Progress: Guidance on Measuring the Reduction of Disaster Risk and the Implementation of the Hyogo Framework for Action

During the preparatory negotiations on the frameworks, participants of the member states stressed the need for specific means including indicators to measure progress toward the reduction of disaster risks. In particular, it was requested that the International Strategy for Disaster Reduction (ISDR) system coordinates the development of "generic, realistic, and measurable indicators" for disaster risk reduction. The "Indicator of Progress" has thus been proposed[2] for the five Hyogo Framework's Priorities for Actions. The indicators are presented in Table 3.2.2.

Based on the Indicator of Progress, member states will undertake the preparation of the national progress report within the framework of the Biennial HFA Monitoring and Progress Review Process, facilitated by the United Nations ISDR (UNISDR) and ISDR system partners.

Table 3.2.2 AADMER WP (2010-2015) Strategic Como

Strategic Component	Sub-component
1. Risk Assessment, Early Warning and Monitoring	1.1 Risk Assessment
	2.2 Early Warning
	3.3 Monitoring
2. Prevention and Mitigation	2.1 Implementing National Plan and Strengthening the Legal and Institutional Framework
	2.2 Mainstreaming DRR in the National Development Plans
	2.3 Mainstreaming DRR in the Education and Health Sectors
	2.3.1 Integration of DRR in the School Curriculum
	2.3.2 Disaster Safety of Educational Facilities
	2.3.3 Disaster Safety of Health Facilities
	2.4 Public Education, Awareness, and Advocacy
	2.5 Urban DRR
	2.6 Community-Based DRR
	2.7 Building Partnerships between DRR and Climate Change Adaptation Institutions and Programs
	2.8 Disaster Risk Financing including Microfinance
3. Preparedness and Response	
4. Recovery	

Source: AADMER Work Program 2010-2015
Note: DRR = Disaster Risk Reduction

3.2.2 AADMER Work Program 2010-2015

Recognizing that the ASEAN region is at high risk to natural disasters, the ASEAN reached a number of mutual agreements starting at the highest level with the ASEAN Declaration on Mutual Assistance on Natural Disasters in 1976. On December 24, 2009, the AADMER: "ASEAN Agreement on Disaster Management and Emergency Response" was entered into effect, which firmly affirms ASEAN's commitment to the HFA. To concretize this commitment and operationalize AADMER, the "AADMER Work Program (WP) 2010-2015"

[2] The test largely refer to Indicator of Progress; ISDR

was designed to support the national agenda and complement capacities of the member states in the different aspects of disaster management to attain the vision of disaster-resilient nations and safer communities within the region.

Being comprehensive, the AADMER WP covers all aspects of disaster management and thus outlines a detailed road map for the four strategic components[3]:

1) Risk assessment, early warning and monitoring;
2) Prevention and mitigation;
3) Preparedness and response; and
4) Recovery

The sub-components are proposed under these four strategic components.

3.3 Items of the Inventory - Inventory as a Tool for Monitoring of Disaster Management Progress

(1) Relationship between AADMER WP and HFA

Having considered the above mentioned background, the inventory was designed so that items in the inventory will correspond to both priority activities and key activities of HFA 2010-1015, as well as to the components and sub-components of the AADMER WP. This is because the ASEAN members are in the process of attaining the disaster-resilient nations in accordance to the AADMER WP, while at the same time; the members prepare national progress reports to UNISDR within the framework of the Biennial HFA Monitoring and Progress Review Process. However, as the AADMER WP is a program that firmly affirms ASEAN commitment to the HFA, individual activity corresponds to each other though categorization of individual activity may differ. Table 3.3.1 shows the relationship among items such as the HFA Key Activities, Indicators of Progress, and the AADMER WP sub-components.

(2) Inventory

The JICA Study Team has updated the inventory with information provided through the questionnaire survey, interview surveys in each member state, and survey on web-sites. Users may find necessary items that may be needed for updating the Biennial Monitoring and Progress Review or for assessing progress of the AADMER WP. At the same time, there were limitations encountered during the data collection survey. An example of the limitations is the limited number of institutions or person in-charge for the interview which resulted to insufficient information source in the inventory. In addition, the availability of topographic maps of each country was summarized in the Appendix-1, as this information is crucial for the preparation of hazard maps and etc.

As monitoring of progress towards building disaster resilient nations and communities is an essential activity to step up at the stage of resilience, it is recommended to update the

[3] The text largely refer to AADMER Work Program 2010-2015

inventory of each state and to share the information with other ASEAN member states possibly through the AHA Centre.

Table 3.3.1 Relations among Items such as HFA Key Activities, Indicators of Progress, and AADMER WP Sub-components

<table>
<tr><th colspan="3">HFA 2010 -2015</th><th colspan="2">AADMER WP 2010 -2015</th></tr>
<tr><th>Priorities for Action</th><th>Key Activities</th><th>Indicators of Progress</th><th>Component</th><th>Sub-components</th></tr>
<tr><td rowspan="4">1</td><td>(i)</td><td>(i)</td><td rowspan="4">2</td><td rowspan="2">2.1</td></tr>
<tr><td>(ii)</td><td>(ii)</td></tr>
<tr><td>(iii)</td><td>(iii)</td><td>2.6</td></tr>
<tr><td>-</td><td>(iv)</td><td>-</td></tr>
<tr><td rowspan="5">2</td><td>(i)</td><td>(i)</td><td rowspan="5">1</td><td>1.1</td></tr>
<tr><td>-</td><td>(ii)</td><td>1.3</td></tr>
<tr><td>(ii)</td><td>(iii)</td><td>1.2</td></tr>
<tr><td>(iii)</td><td>-</td><td>-</td></tr>
<tr><td>(iv)</td><td>(iv)</td><td>-</td></tr>
<tr><td rowspan="4">3</td><td>(i)</td><td>(i)</td><td rowspan="4">3</td><td>-</td></tr>
<tr><td>(ii)</td><td>(ii)</td><td>2.3.1</td></tr>
<tr><td>(iii)</td><td>(iii)</td><td>-</td></tr>
<tr><td>(iv)</td><td>(iv)</td><td>2.4</td></tr>
<tr><td rowspan="6">4</td><td>(i)</td><td>(i)</td><td rowspan="6">2</td><td>2.7</td></tr>
<tr><td rowspan="2">(ii)</td><td>(ii)</td><td rowspan="2">2.3.2
2.3.3
2.8</td></tr>
<tr><td>(iii)</td></tr>
<tr><td rowspan="3">(iii)</td><td>(iv)</td><td rowspan="3">2.5</td></tr>
<tr><td>(v)</td></tr>
<tr><td>(vi)</td></tr>
<tr><td rowspan="4">5</td><td rowspan="4">-</td><td>(i)</td><td rowspan="4">3
(4)</td><td rowspan="4">3
(4)</td></tr>
<tr><td>(ii)</td></tr>
<tr><td>(iii)</td></tr>
<tr><td>(iv)</td></tr>
</table>

Source: JICA Study Team

3.4 Summary of Progress of HFA

"Indicators of Progress: Guidance on Measuring the Reduction of Disaster Risks and the Implementation of the Hyogo Framework for Actions" are used by member states to monitor and report the progress of priority actions in HFA 2005-2015 as "National Progress Report on the Implementation of the Hyogo Framework for Action". The progress reports of the ten ASEAN member states were summarized and shown in Figure 3.4.1 below.

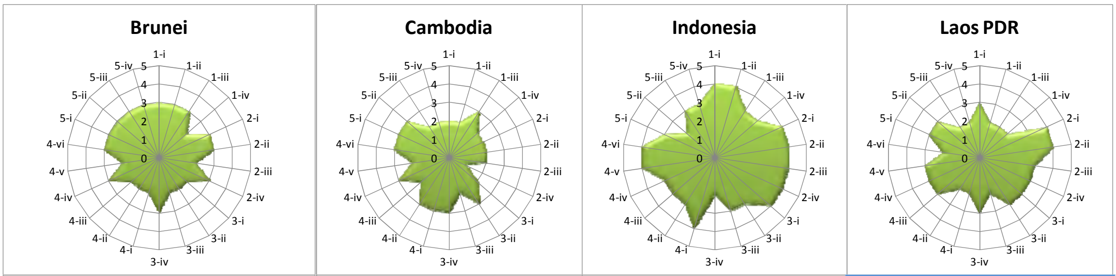
Although the Study Team understands that simple comparison may not be appropriate due to various natural and social conditions of each state, overall observations are as follows:

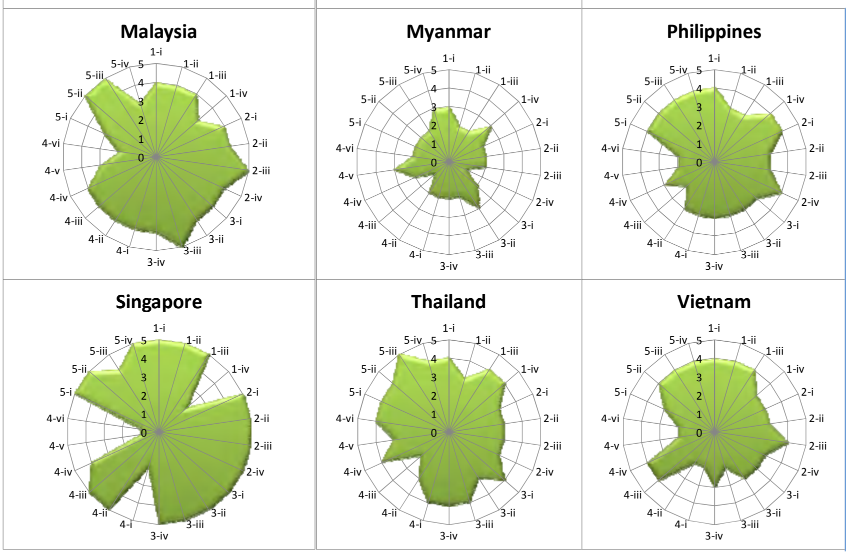
1) The best progress is seen for the case of Malaysia and Singapore (total score: over 80);
2) Considerably good progress are seen for Indonesia, Philippines, Thailand, and Vietnam (total score: over 70);

3) Further efforts need to be made for Brunei, Cambodia, Lao PDR, and Myanmar (total score; below 70)

It should be noted that scores of core indicators that are not so relevant to the states are represented as ‘low progress’ such as HFA-1-iv, 4-v, and 4-vi like for Singapore where needs for these core indicators are not so essential because disasters are not severe.

The progress may be cross-checked in details through the updated inventories, and thereby which priority action has to be emphasized or needs to be identified for further efforts for the individual state or for ASEAN regional cooperation.





Five Priority Actions		Core Inicator	
HFA-1	Governance: Ensure that Disaster Risk Reduction is a National and a Local Priority	i	Legal framework
		ii	Resources availability
		iii	Community participation
		iv	Multi-sectoral platform
HFA-2	Risk Assessment: Identify, Assess and Monitor Risk and Enhance Early Warning	i	Risk assessment
		ii	Monitoring system
		iii	early warning system
		iv	Regional cooperation
HFA-3	Knowledge: Use Knowledge, Innovation and Education to Build a Culture of Safety and Resilience at All Level	i	Information sharing system
		ii	School curricula
		iii	Research methods
		iv	Public awareness
HFA-4	Risk Reduction: Reduce the underlying Risk Factors	i	Environmental policy
		ii	Social development
		iii	Economic, productive sectoral policy
		iv	Human settlement
		v	Post-disaster recovery, rehabilitation
		vi	disaster risk assessment in infrastructure
HFA-5	Preparedness: Strengthen Disaster Preparedness	i	Policy and mechanism
		ii	Preparedness plan
		iii	Financial reserves
		iv	Information exchange

Data Source: National Progress Report on the Implementation of the Hyogo Framework for Action (extracted from respective report of ASEAN countries). Apart from Cambodia and Singapore (report period: 2007-2009), the referred reports of eight other countries were covered between 2009 and 2011. (Charts prepared by the JICA Study Team)

Note. : Such symbols as 1-i, 1-ii in the charts, indicated the core indicators HFA-1-i and HFA-1-ii as shown in the legend in the Table. Also see Table 3.2.1 for more details.

: Scores that are not relevant to the countries are expressed as low score such as 4-v and 4-vi for Singapore.

Figure 3.4.1 Progress of HFA 2005-2015 of Ten ASEAN Countries

CHAPTER 4 NEEDS IDENTIFICATION FOR DISASTER MANAGEMENT

This chapter summarizes the survey results and describes the proposals for ASEAN regional collaboration in disaster management. For more detailed observations and information, please refer to the Chapters 5 to 9 of this report, and the Inventory attached.

4.1 Issues and Needs According to Themes

4.1.1 Institution / Organization

(1) Institutional Issues: Disaster Management Law

In keeping with the strategic goals of Hyogo Framework for Action (HFA), ASEAN countries have shifted their disaster management policy focus from responsive to preventive and mitigating orientation. As such policy shift is still in transition, not all ASEAN countries have established their institutional foundation in terms of legal and organizational arrangements.

Out of ten ASEAN countries, four countries (Brunei, Indonesia, the Philippines, and Thailand) have disaster management law. Three countries, namely Cambodia, Myanmar, and Vietnam, are in the process of enacting their disaster management law within 2012 or in 2013. Lao PDR expects to formulate and enact disaster management law by 2013. Malaysia needs more steps to start preparing its disaster management law. It seems unnecessary for Singapore to have its comprehensive disaster management law aside from other related laws, because it is relatively free from natural hazards.

Disaster management law is fundamental especially for effectively conducting disaster preventive/mitigating activities as government budget allocation for disaster management attributes to its legal basis. While many countries have spared a portion of special budget through emergency funds when disaster strikes, an integrated budget for comprehensive disaster prevention and mitigating activities is scarcely prepared as these resources are normally allocated to respective sector ministry without sufficient coordination. Such integration of the budget will, on the other hand, require a comprehensive disaster management plan and a specialized agency as its preconditions.

(2) Institutional Issues: Disaster Management Plan and Organization

1) Readiness of Disaster Management Plan of ASEAN countries

Preparation of disaster management plan varies from country to country among ASEAN countries. Four out of ten ASEAN countries (Indonesia, the Philippines, Thailand, and Vietnam) possess disaster management plans. Brunei’s disaster management plan consists of: i) Strategic National Action Plan and ii) Standard Operating Procedure. Cambodia had a plan for some years but has not been implemented as intended because its legal basis was not yet put into place. Lao PDR is currently drafting the plan to obtain legal approval. Myanmar is in the process of revising its plan together with necessary legal re-arrangement including organizational re-structuring (to be completed within 2012). It seems enough for Singapore to have existing national contingency plan. Disaster management plans at the local level are also expected to be prepared; however, it is an issue for most of ASEAN countries in terms of how these will be well-prepared.

2) Disaster Management Organization at the National Level

All ASEAN countries have disaster management organizations. Most of them are composed of committees presided by high level government authority and secretariats, which are most likely under the leading ministry for disaster management. These committees are organized mainly for emergency response, and the secretariats are expected to deal with disaster prevention, mitigation and preparedness apart from emergency arrangements, without enough resources and authority in most cases. Although a shift of policy focus on disaster management from emergency response to prevention, mitigation, and preparedness has been observed in most of ASEAN countries, it would be necessary for existing secretariat organizations to have clearer mandates and authority or to be an independent agency just like a case of Indonesia in order to make inter-governmental coordination as well as disaster management activities smooth.

Table 4.1.1 Institutional Conditions of Disaster Management in ASEAN Countries

Institutional Conditions			Brunei	Cambodia	Indonesia	Lao PDR	Malaysia	Myanmar	Philippines	Singapore	Thailand	Vietnam
Disaster Management Law	Presence		O	<2013>	O	<2013>	-[*2]	<2012>	O	-[*3]	O	<2013>
	Enacted <Planned> Year		2006[*1]		2007				2010		2007	
Disaster Management Plan	Presence at the National Level		O[*4]	O[*5]	O	-[*6]	-[*7]	O	O	O[*8]	O	O[*9]
	Presence at the Local Level		O	O	O	O[*10]	O[*11]	.	O	-[*12]	O	O
Disaster Management Organization	National Level	Committee	O	O	O[*13]	O	O	O	O	O	O	O
		Secretariat	O[*14]	O		O	O	O	O	O	O	O
	Local Level		O	O	O	O	O	O	O	-[*15]	-[*16]	O
Community-based Disaster Management			O	-[*17]	-[*17]	-[*17]	-[*17]	-[*17]	-[*17]	O	-[*17]	-[*17]

Source: JICA Study Team

Note: 'O': Available; '-': Not Available

1*: Disaster Management Order subrogates the law; 2*: Malaysia needs more steps to start preparing disaster management law; 3*: It seems unnecessary for Singapore to have comprehensive disaster management law aside from other related laws because it is relatively free from natural hazards; *4: It consists of SNAP and SOP; *5: Implementation issue exists; *6: It will be approved within 2012; *7: SOPs subrogate it; having the plan is considered unnecessary; *8: Emergency plan subrogates it; *9: The plan is to be revised; *10: Five out of 16 provinces prepared it; *11: It will be revised; *12: It seems not necessary; *13: Committee is within the implementing organization; *14: It is still an interim arrangement; *15: It seems not necessary; *16: Local administrations provided its function; *17: Implemented mainly through donor-led program.

3) Disaster Management Organization at the Local Level

Disaster management organizations are also set up locally in most of ASEAN countries. Many of them, however, are established in order to prepare/respond to emergency circumstances which frequently and seasonally occur. Local disaster management organizations are expected to prepare local disaster management plans on the basis of their respective national plan, which extend their functions to mitigation and prevention activities. Local disaster management organizations are also involved in the community-based disaster management activities, with the assistance of external donors in most cases. Generally, community-based disaster management seems not comprehensive as its activities are partial and often serve as ad hoc through donor supports. To make it sustainable, it needs an institutional foundation at the local level by enhancing the capacity of local government organization for disaster management.

Table 4.1.1 summarises the institutional/organizational conditions of ASEAN countries.

According to the information in Table 4.1.1 concerning institution and organization matters obtained by the study, the JICA Study Team identifies and summarizes the issues and needs for cooperation as shown in Table 4.1.2 The JICA Study Team considers that the cooperation can be provided bilaterally between Japan and respective ASEAN country, or can be regionally provided among ASEAN countries as shown in Table 4.1.3.

Table 4.1.2 Issues and Needs on Institution/Organization

Issues and Needs	Country									
	Brunei	Cambodia	Indonesia	Lao PDR	Malaysia	Myanmar	Philippines	Singapore	Thailand	Vietnam
1. Improve the legal system for disaster management	-	O	-	O	O	O	-	-	-	O
2. Build intelligence infrastructure for disaster prevention plan as well as mitigation measures	-	O	-	O	O	O	-	-	-	O
3. Formulate or update the national disaster management plan	-	O	-	O	-	O	-	-	-	-
4. Implement local disaster management plan and community based disaster management	-	O	O	O	O	O	O	-	O	O
5. Strengthen the organization and functions (shifting from response to prevention and mitigation) of disaster management institutions	-	O	-	O	-	O	-	-	-	O

Source: JICA Study Team

Note: ‘O’: Issues/needs identified; ‘-’: Issues/needs not particularly identified

Table 4.1.3 Issues and Needs for Institutional Improvement of ASEAN Countries

Issues and Needs	Countries	Bilateral/ ASEAN Regional Cooperation
Improvement of legal system for disaster management	Cambodia Lao PDR Malaysia Myanmar Vietnam	(1) Bilateral cooperation International survey for information collection to standardize disaster management law for preparation, modification, and enforcement. (2) ASEAN cooperation Standardization of ASEAN disaster management institutional arrangement. (Lead countries: Indonesia and Thailand)
Building intelligence infrastructure for disaster prevention as well as mitigation measures to be planned	Cambodia Lao PDR Malaysia Myanmar Vietnam	(1) Bilateral cooperation Information collection on disaster management plans and its frameworks for replication referring Japan's plan and framework as a basic case. Mitigation measures of every disaster are also collected for reference. (2) ASEAN cooperation Sharing basic information on disaster management plans and mitigation measures with each other in a comparative manner, for regional knowledge base to be created.
National disaster management plan to be formulated or updated	Cambodia Lao PDR Myanmar	(1) Bilateral cooperation Using the frameworks of national disaster management plan of Japan, comprehensive framework is clarified. (2) ASEAN cooperation Standardization and modelling of national disaster management plan extracting good practices of ASEAN countries for replication and mutual learning.
Local disaster management plan and implementation of community based disaster management	Cambodia Lao PDR Malaysia Myanmar Philippines Thailand Vietnam	(1) Bilateral cooperation Using the frameworks of local level disaster management plan of Japan, comprehensive framework is clarified for local level planning (community based disaster management component is also included). (2) ASEAN cooperation Standardization and modelling of local disaster management plan as well as community based disaster management practices extracted from ASEAN countries for replication and mutual learning.
Organizational and functional strengthening (shifting from response to prevention and mitigation) of disaster management institutions	Cambodia Lao PDR Myanmar Vietnam	(1) Bilateral cooperation Optimization of disaster management organizations including law revision. Support capacity development of professional staffs in the area of disaster management. (2) ASEAN cooperation Standardization of disaster management organizational structures and functions by referring the cases of advanced ASEAN countries (e.g., Indonesia and Thailand) and support latecomers.

Source: JICA Study Team

4.1.2 Risk Assessment, Early Warning and Mitigation

(1) Flood Disaster Management

1) Recent Trends of Flood Damages and Overview of Needs of Countermeasures

The Typhoon Ketsana caused extensive flood damages to the Philippines, Vietnam, Cambodia, Laos, and Thailand in 2009. Moreover, the compounded impact of Tropical Storm Haima and Typhoon Nock-ten caused extensive damages to Myanmar, Thailand, Laos, and Cambodia in

2011. The severe flood events have confirmed major issues regarding flood damages of recent years in the ASEAN countries.

While occurrences of flash floods of rivers in mountainous and/or semi-arid lands as well as common riveine floods have been recognized, the issues on urban-type floods and urban drainage associated with rapid development of economic zones and urbanization have become obvious. It has been recognized that an increasing speed of flood peak discharge associated with development of economic zones and urbanization tends to be more rapid compared to a variability of rainfall caused by climate change. An increase of flood runoff ratio (an increase of hazard) combined with development; urbanization and expansion of slums caused by increase in poverty have rapidly aggravated the vulnerability of urban areas to floods. As a result, quantitative assessment and identification of flood risk has been highlighted as a major issue. An increase in flood risks has enhanced needs of flood insurance. Rising of sea level caused by global warming have also increased fears of flooding in agricultural areas (Mekong Delta) and urban areas (Jakarta, Ho Chi Min).

Table 4.1.4 Summary on the Preparation of Flood Hazard Map

Country / *Region*	Preparation of Flood Hazard Map			
	Status	Covered Area	Map Scale	Information Source
Brunei	Completed	Whole country	To be confirmed	Interview
Cambodia	In preparation	Whole country	Large scale usable only for policy decision	Interview
Indonesia	Completed (large scale map)	Whole country	Each Province Level	BMKG’s website
Lao PDR	Partially completed	8 Flood Prone Areas	1:90,000 – 1:550,000	ADPC’s report
Malaysia	Partially completed	15 Flood Prone Areas	To be confirmed	DID’s PPT
Myanmar	In preparation	Bago region	To be confirmed	Interview
Philippines	Partially completed	22 Provinces	To be confirmed	Interview
Singapore	Completed	Whole country	1:36,000	PUB’s website
Thailand	Partially completed	Whole country	To be confirmed	Govt.’s PPT
Vietnam	Partially completed	4 Provinces	To be confirmed	Interview
Mekong Basin	*Completed*	*Middle to lower reach*	*1:400,000*	*MRC’s website*

Source: JICA Study Team
Note: The above summary does not totally represent all the information provided.

2) Preparation of Hazard Maps

Efforts have been made by ASEAN member countries in order to prepare hazard maps as shown in Table 4.1.4. However, most of the maps are of scales that are to be used for policy decisions. Those that are yet to be prepared are maps with detailed scales that will be used at the community level for preparedness and emergency response, or for detailed damage analysis for insurance purposes. This may be due to insufficient human and financial resources, including material resources such as topographic base maps of adequate scales.

The study classified the purposes of flood risk assessment as shown in Table 4.1.5 for better understanding.

Table 4.1.5 Purposes of Flood Risk Assessment and the Corresponding Description

Purpose	Description
Policy Making	Formulation of the national and regional development policies on strategic areas for disaster prevention, identification of model areas, and budgetary arrangements
Flood Management Planning	Preparedness for emergency actions (evacuation and rescue) and relief actions
Preparedness and Emergency Actions	Information for disaster mitigation and prevention planning, and river basin flood control master plan
Damage Analysis	Damage analysis for investment on regional industrial clusters and insurance on factories, buildings, and utilities; risk assessment on economic corridors such as roads, ports, and railways

Source: JICA Study Team (Draft Guide to Flood Risk Assessment)

Table 4.1.6 and Table 4.1.7 list example information required for corresponding purposes at the national and local levels, as well as for the local and community levels, respectively.

Table 4.1.6 Required Information for Policy Making and Flood Management Planning

Purpose	National	Local
Policy Making	Map scale: 1:100,000– 1,000,000; Administrative boundaries; Inundation areas, water depth; Notation of flood risk class: Return period of flooding	Map scale: 1:50,000–250,000; Administrative boundaries; Inundation areas, water dept; Notation of flood risk class; Return period of flooding
Flood Management Planning	Map scale: 1:5,000-25,000 with contour lines and spot elevations; Administrative boundaries; Inundation areas, water depth, flow velocity, return period; Notation of flood risk class or water depth; Land uses (agricultural, industrial, commercial, residential, forest, swamp); Dikes, dams, retarding ponds, drainages, pumping stations; Roads, railways, bridges, port, air port, power stations, water supply facilities	Map scale: 1:5,000-25,000 with contour lines and spot elevations; Administrative boundaries; Inundation areas, water depth, flow velocity, return period; Notation of flood risk class or water depth; Land uses (agricultural, industrial, commercial, public, forest, swamp; Dikes, dams, retarding ponds, urban drainages; Roads, railways, bridges, port, air port, power stations, water supply facilities

Source: JICA Study Team (Draft Guide to Flood Risk Assessment)

Table 4.1.7 Required Information for Preparedness and Damage Analysis

Purpose	Local	Community
Preparedness and Emergency Actions	Map scale: 1:5,000-15,000 with contour lines and spot elevations; Administrative boundaries; Inundation areas, water depth, flow velocity, return period of flood; Dikes, flood posts, laud speaker posts, shelters, schools, dams, retarding ponds, drainages; Roads, railways, bridges; Safe evacuation routes,	Map scale: 1:5,000 – 15,000 or Google map, sketch map; Village or community boundaries; Inundation areas, water depth, flow velocity, return period of flood; Safe evacuation routes; Dikes, flood posts, laud speaker posts, shelters, schools, retarding ponds, drainages, ground water wells; Roads, railways, bridges,
Damage Analysis	Map scale: 1:5,000-25,000 with contour lines and spot elevations; Administrative boundaries; Inundation areas, water depth, flow velocity, return period; Notation of flood risk class; Land uses (agricultural, industrial, commercial, residential, forest, swamp); Flood control level of dikes, dams, retarding ponds, drainages, pumping stations; Roads, railways, bridges, port, air port, power stations, water supply facilities; Population distribution, transport quantity of trunk main roads and ports, production turnover of industrial parks; Rainfall depth, geology and forestation for land slide risk assessment.	

Source: JICA Study Team (Draft Guide to Flood Risk Assessment)

3) Issues and Needs

The common issues and needs on flood disasters for ASEAN countries are summarized in Table 4.1.8 below.

Table 4.1.8 Issues and Needs on Flood Disasters

Issues and Needs on Flood Disasters	Country									
	Brunei	Cambodia	Indonesia	Lao PDR	Malaysia	Myanmar	Philippines	Singapore	Thailand	Vietnam
Flood early warning system and integrated planning against wide range of floods caused by typhoons and cyclones	-	O	-	O	-	O	O	-	O	O
Flood early warning system and integrated planning against flash floods occurred in the mountainous areas, urban areas, and semi-arid lands	O	O	-	O	O	O	O	-	O	O
Flood control and drainage planning for urban areas and SEZ (securement of safety degree against floods in urban areas, SEZ, and supply chains)	-	O	P	P	P	P	-	P	O	O
Flood control planning in economic corridors including roads and ports (securement of safety degree against floods in supply chains)	-	O	-	P	P	P	-	-	O	-
Urban drainage planning associated with urban land subsidence, storm surges, and rising of sea level	-	-	O*1	-	-	-	-	-	-	O*2
Flood risk assessment survey for the purposes of investment risk assessment and flood insurance (including development of flood hazard maps)	-	O	O	O	O	O	-	-	O	O
Improvement of the legal frameworks for the enactment of reservoir operation rule (Improvement of legal systems in order to prevent artificial flood disasters caused by inappropriate reservoir operation of PFI hydropower dams)	-	O	-	O	-	O	O	-	O	O

Source: JICA Study Team
Legend: 'O' = Considered to be necessary; 'P' = considered to be potentially necessary;
'-'= Information was not made available to consider
Note 1: Regarding urban drainage planning associated with urban land subsidence, storm surges and rising of sea level, the above table shows only areas that were raised in the interview with the JICA Study Team (*1*2).
Note 2: *1 Indonesia (DKI Jakarta); *2 Vietnam (Ho Chi Ming, Mekong Delta area)

4) Proposed Aid Projects for Flood Disasters in Each ASEAN Country

To solve the above-mentioned issues, it is proposed to implement the following aid projects in each ASEAN country:

Table 4.1.9 List of Proposed Aid Projects on Flood Disasters in Each ASEAN Country

Country	List of Project
Brunei Darussalam	Although the country suffers from flash floods, it is possible to procure countermeasures by the country's own fund.
Cambodia	(i) Formulation of the Strategic Flood Control Plan in the Kingdom of Cambodia (ii) Master Plan Study on Integrated Flood Management in the Siem Reap River Basin (iii) Review of Master Plan for Urban Drainage in Phnom Penh (iv) Study on Flood Risk Assessment for SEZs in the Kingdom of Cambodia (v) Study on the Improvement of Legal Systems for Enactment of Reservoir Operation Rules (vi) Capacity Development of MOWRAM for Flood Management
Indonesia	(i) Study on Flood and Earthquake Risk Assessment in Bukasi – Karawang Region (ii) Study on Flood and Earthquake Risk Assessment for Economic Corridors Including Tanjung Priok Port, New Kalibau Container Terminal and Planned New Airports
Lao PDR	(i) Formulation of the Strategic Flood Control Plan in Lao People's Democratic Republic (ii) Master Plan Study on Urban Drainage in Vientiane (iii) Study on Flood Risk Assessment for SEZs in Lao People's Democratic Republic (iv) Study on the Improvement of Legal Systems for Enactment of Reservoir Operation Rules
Malaysia	(i) Study on Flood Risk Assessment for the Economic Corridor Johor – Kuala Lumpur – Penan – Kuda
Myanmar	(i) Master Plan Study on Integrated Flood Management in the Sittang River and the Bago River Basins (ii) Study on Flood Risk Assessment for the Thirawa SEZ (iii) Master Plan Study on Urban Drainage in Yangon
Philippines	(i) Technical assistance for development of flood hazard map and flood risk assessment depending on the intended use (ii) Study on the Improvement of Legal Systems for Enactment of Reservoir Operation Rules
Singapore	Urban drainage measures for Orchard Road (commercial accumulation zone): Although it is possible to procure countermeasures by the country's own fund, the issue has not been solved. There is an option that a private sector provides technical assistance for underground drainage tunnel, underground reservoir, pumping facilities, etc., which have been implemented in Tokyo.
Thailand	(i) Urgent Study on the Improvement of Legal Systems for Restructuring of Flood Reinsurance
Vietnam	(i) Master Plan Study on Urban Drainage in Hanoi (ii) Study on Flood Risk Assessment for the West Hanoi SEZ (iii) Master Plan Study on Urban Drainage in Ho Chi Minh (iv) Formulation of the Strategic Flood Control Plan in Can Tho

Source: JICA Study Team

3) Proposed Projects on Flood Disaster for ASEAN Collaboration

The following projects are expected to be more effective if they are implemented through ASEAN collaboration:

- Preparation of guideline on the improvement of legal systems for enactment of reservoir operation rules
- Preparation of guideline on flood risk assessment

(2) Earthquake and Tsunami Disaster Management

The present situation of monitoring and early warning system of the ASEAN member countries are summarized in the Table 4.1.10 below. For reference, the number of monitoring points in Japan is included.

Table 4.1.10 Present Situation of Monitoring and Early Warning System in ASEAN Region

	Country	Broadband Seismograph	Accelero-graph	GPS	Tsunami		EWS for Tsunami	Warning System
					Buoy	Gage		
Earthquake Countries	Indonesia	160	216	20	23 (2 Operational)	58	BMKG (InaTEWS)	24 Sirens
	Myanmar	12 (5 Operational)	11	0	0	2	nil	nil
	Philippine	66	6	2	1 (Wet Censor)*1	47	PHIVOLCS	Each Barangay
	Thailand	41	22	5	3 (All damaged)	9	NDWC	328 Warning Tower
Surrounding Countries	Brunei	*tbc*	*tbc*	*tbc*	*tbc*	Installed	nil	nil
	Cambodia	nil	nil	nil	nil	nil	nil	nil
	Lao PDR	2	2	9	-	-	-	-
	Malaysia	17	13	191	3	17	MMD (MNTEWC)	23 Sirens
	Singapore	2	6	*tbc*	0	12	MSS (TEWS)	Installed
	Vietnam	15	*tbc*	*tbc*	*tbc*	2	IoG	10 Sirens
Japan (March 2012)		*142 (HSS*2=1,270)*	*3,559*3 724*4*	*1,494*	*Tidal gauge + tsunami gauge=247*5*		*JMA, others*	*Sirens/ TV /Radio /others*

Source: All the information of ASEAN countries was collected by the JICA Study Team (2012); Information of Japan was from HP of Headquarters for Earthquake Research Promotion;
Note: *tbc*: to be confirmed; *1 WET censor: tsunami detecting censor installed at coast land; *2: HSS: High sensitivity seismograph; *3: surface type, there are about 2,900 other points; *4: underground type; *5: there are 15 GPS tidal gauges and 35 water pressure gauges at the bottoms of the sea;

The density of monitoring instruments may differ from country to country depending on the policy taken for disaster management. In Japan for example, a monitoring network was planned to achieve (i) real time monitoring of seismic motion when eathquakes occur, (ii) understanding of geological structures that enhance seisminc motion, (iii) forcasting of strong seismic motion when earthquakes occur, (iv) real time forcasting of tsunami when earthquakes occur and (v) evaluation of possibility of tunami-earthquake (stealth earthquake). To realize those, the plan is to propose intervals of monitoring devices, which are 15-20 km for height sensitivity monitoring seismograph, 100 km for broadband seismograph, 15-20 km for accelerograph, and 20-25 km for GPS[1]. As a result, considerably dense monitoring networks have been established as shown in Table 4.1.10.

[1] "Fundamental Research and Monitoring Plan for Earthquake", August 1997, Headquarters for Earthquake Research Promotion, Japan (in

1) Indonesia

a) Enhancement of the tsunami observation system for Indonesia Tsunami Early Warning System (InaTEWS).

- Indonesia intended to establish the monitoring network for InaTEWS consisting of 160 broadband seismographs, 500 accelerometers, 40 GPSs, 80 tide gauges and 23 buoys[2].
- As shown in Table 4.1.10, the number of monitoring facilities excluding broadband seismographs, has to be increased to achieve the plan. In particular, tsunami observation buoys or other observation facilities have to be installed to the original level. Presently, the buoy observation facilities are proven to be not sustainable[3]; therefore, options such as new submarine water pressure gauge system or other alternatives have to be considered.
- As for the tide gauges, information from some gauges are transmitted to BMKG via satellite with 15 minutes delay. It is understood that the system is being upgraded to transmit data via GTS to achieve near real time monitoring.

b) Formulation of disaster management plan and BCP for Jakarta

- The Study Team also recommends an earthquake disaster management plan for Jakarta City since large scale earthquakes have not occurred for a long period. Considering that Jakarta is now being developed as an economic center of the ASEAN region, such plan is necessary to minimize effects to the city due to damage caused by large scale earthquakes.
- As recommended in the other section of this report, a comprehensive disaster management plan that includes not only earthquake/tsunami but flood as well, is recommended for formulation.
- Based on the comprehensive disaster management plan, BCP for the city will have to be formulated.

c) Research on seismology and tsunami

- Research in seismology for east Indonesia is needed, in particular for the regions facing Cleves Sea where large earthquakes are observed to occur.
- Detailed tsunami simulations have been conducted by various agencies. It is necessary to integrate these results of tsunami simulation into InaTEWS.

2) Myanmar

a) Development of earthquake and tsunami observation network and capacity development for observation and analysis

- Earthquake monitoring facilities are obviously not enough as shown in Table 4.1.10. It is recognized by the Department of Meteorology and Hydrology (DMH) that seismic and tsunami observation network and early warning system should be urgently developed.

(In Japanese)

[2] Indonesia Tsunami Early Warning System (InaTEWS): Concept and Implementation (2008)

- Also, capacity development is indispensable to engineers in charge of the operation of observation system and early warning system, and analysis of earthquake characteristics (hypocenter, magnitude, and so on).

b) Formulation of disaster management plan and BCP for the main cities

- The main cities including Yangon City are located at an earthquake prone area where Sagaing Fault lies nearby and many large earthquakes have occurred. On the other hand, Yangon City as well as a new economic special zone is being developed rapidly. It is necessary to develop an earthquake and tsunami disaster management plan and BCP for Yangon City, including the special economic zone.

3) Philippines

a) Enhancement of earthquake and tsunami monitoring networks

- Under the Science and Technology Research Partnership for Sustainable Development (SATREPS), efforts were made for real-time earthquake monitoring, advanced source analyses and intensity observation, and evaluation of earthquake generation potential. For this purpose, broadband seismographs and accelerographs were installed, and integrated to the existing satellite telemeter monitoring network in order to realize/improve rapid estimation of ground motion, liquifaction, landslide, and tsunami through enhanced Rapid Earthquake Damage Assessment System (REDAS).
- On the other hand, it is understood that the Philippine Institute of Volcanology and Seismology (PHIVOLCS) intends to increase the number of tsumani monitoring guages rather than increasing the number of broadband seismometer. Presently, tsunami is monitored using one ‘wet censor’ (see Table 4.1.10) that is a water level guage installed at the coast remote islands, although a total of ten wet censors were originally considered to be installed[4].
- In any case, the number of tsunami observation facilities off the coast are not sufficient and should be increased.
- Similarly, the number of GPSs and accelerometer should also be increased to monitor the activities of numerous active faults traversing in the Philippines archipelago.

b) Integrated Urban Disaster Management Plan for Metropolitan Manila and Surrounding Areas

- An earthquake disaster management plan for Metropolitan Manila was conducted through JICA’s technical cooperation project in 2004. Through the detailed discussions on damage estimation, emergency response, Community-Based Disaster Risk Management (CBDRM) and other existing conditions in Manila, and necessary mitigation measures were recommended.
- Since the JICA project was conducted, urbanization of Manila area has progressed rapidly towards outside the Metropolitan area such as Marikina, Rizal, Bulacan, Cavite, and Laguna, with a total population reaching 25 million. Systematic consideration to disaster protection infrastructures have not been given to these areas, which has increased the vulnerability of Mega-Manila to disasters.

[4] http://tsunami.ihs.ncu.edu.tw/~scstw/2007/doc/5a_01_(Dr.Dimalanta)_Tsunami%20research%20activities_Dimalanta.pdf

- The JICA Study Team therefore considers that review and updating of earthquake damage estimation is required in Manila including surrounding areas of Metropolitan Manila.
- Also, it is necessary to review the tsunami disasters along the coastal area of Manila Bay based on possible earthquake warning raised by the United States Geological Survey (USGS) at the Manila Trench.

c) Earthquake Damage Estimation and Integrated Urban Disaster Management for Large Local Cities such as Cebu and Davao.

- The basic concept of this project is same as that proposed for Metropolitan Manila. Cebu City and Davao City are big cities in the central and southern Philippines. Both cities are located at earthquake prone areas, where topographical condition is mainly coastal lowland. Thus, in case strong earthquakes occur, extensive damages of both ground shakings and tsunamis are expected are expected.
- In order to take necessary earthquake disaster prevention measures, it is necessary to conduct damage estimation and formulate integrated disaster management plans.
- Based on the disaster management plan, priority projects for damage reduction should be selected and implemented.

4) Thailand

The Thai Meteorological Department (TMD) has installed 41 broadband seismographs installed (see the Table 4.1.10) with intervals shorter than 150 km except at some points; nine tidal gauges covering tsunami prone coastal area; and 22 accelerometer in the northwest part where many active faults are located. This deployment was achieved based on the two phased Seismic Network Project (Phase-I: 2005-2006; Phase-II: 2006-2009) initiated after the Sumatra earthquake in 2004. There may not be urgent needs for increasing monitoring stations, except replacing the damaged tsunami buoys. Issues and needs that the Study Team identified are as follows:

a) Study on the development of earthquake monitoring system and disaster prevention plan in northern Thailand

- Earthquakes epicenters in Myanmar and Lao PDR also caused damages to Thailand. However, the seismic observation networks in Myanmar and Lao PDR have not been developed well. The Study Team considers that Thailand may be in a position to assist its surrounding countries in establishing a seismic monitoring network in the bordering areas through installation of monitoring equipment and/or providing technical assistances.
- Based on the results of seismic observations, an earthquake disaster prevention plan on earthquake-resistant design and earthquake-induced landslides in northern Thailand is necessary.

5) Other Countries

a) Brunei, Malaysia, and Vietnam

Tsunamis possibly induced by earthquakes along the Manila Trench in the South China Sea will reach the coastal areas of Brunei, Malaysia, and Vietnam. These countries raised this subject and recognized the need for the establishment of monitoring and early warning system. Consequently, the Study Team recommended the formulation of tsunami disaster management plans while conducting risk/impact assessment. In particular, Brunei and Vietnam should enhance their tsunami monitoring and early warning system (Malaysia has developed their own systems: MNTEWS).

b) Lao PDR

Development of seismic observation network and capacity development for the operation of observation network

- Earthquakes have occurred in the areas bordering Thailand and Myanmar. Monitoring facilities are definitely insufficient as shown in Table 4.1.10. Moreover, there is a need for capacity building of seismic engineers in terms of operation and maintenance of instruments and analysis of data as well.
- With the growing economy in main cities such as Vientiane, analysis technique for strong motion observation data need to be improved; and quake-resistance standards need to be developed.

c) Cambodia and Singapore

Both Cambodia and Singapore are almost free from earthquake and tsunami disasters. No urgent issues and needs were identified.

Table 4.1.11 List of Main Projects on Seismic and Tsunami Disaster Management

Country	Project
Countries for detailed survey	
Indonesia	1) Enhancement of the tsunami observation system for InaTEWS 2) Formulation of disaster management plan and BCP for Jakarta 3) Research on seismology and tsunami
Myanmar	1) Development of earthquake and tsunami observation network and capacity development for observation and analysis 2) Formulation of disaster management plan and BCP for main cities
Philippines	1) Enhancement of earthquake and tsunami monitoring networks 2) Integrated urban disaster management plan for Metropolitan Manila and its surrounding areas 3) Earthquake damage estimation and integrated urban disaster management for large local cities such as Cebu and Davao
Thailand	1) Study on the development of earthquake monitoring system and disaster prevention plan
Other countries	
Brunei, Malaysia, Vietnam	1) Formulation of tsunami disaster management plan including disaster risk assessment, proposing tsunami monitoring, and early warning systems 2) Regional collaborative research on the mechanism and characteristics of earthquake and tsunami induced by Manila trench
Lao PDR	3) Development of earthquake observation network and capacity development for operation of observation network.
Singapore, Cambodia	No particular issues and needs were identified.

Source: JICA Study Team

(3) Other Natural Disaster Management

Volcano Disasters Management

The Centre for Volcanology and Geological Hazard Mitigation (CVGHM) in Indonesia and PHIVOLCS in the Philippines are leading agencies that have developed volcanic hazard maps, monitoring and early warning systems targeting active volcanoes. In case of eruptions, said agencies issue evacuation orders based on their monitoring information.

When Merapi of Indonesia erupted in 2006 and 2010, 110,000 and 151,745 people were affected while less than 10 and 386 were killed, respectively. It is said that the early warnings based on monitoring were timely issued.

When Mt. Mayon of the Philippines erupted in 2006, and 2009-2010, though 43,849 and 141,161 people, respectively, were evacuated, no causalities were reported. This is because of the effective monitoring and early warning, and evacuation education conducted. However, following the eruption in 2006, strong rainfall produced lahar from the volcanic ash, causing boulders from said eruption to kill 1,266 people. Thus, PHIVOLCS has to enhance their monitoring and early warning plan for similar secondary disasters in its program.

SATREPS was implemented in these two countries to improve their monitoring and early warning systems of volcanic activities. Moreover, continuous improvement/enhancement of their existing volcanic observation networks is required.

Needs for volcanic disaster in ASEAN countries are summarized in Table 4.1.12.

Table 4.1.12 List of Draft Main Cooperation Project for Volcanic Disaster

Country	Project
Indonesia	- Improvement/enhancement of the existing volcanic observation network
Philippines	- Expansion of volcanic observation systems - Development of a regional disaster prevention plan

Source: JICA Study Team

Sediment Disasters Management

Sediment disasters have occurred in mountainous areas including not only in residential areas, but also along trunk roads being utilized as economic supply chains. The disasters have affected human lives and social-infrastructures. Sediment disaster prevention measures to ensure a safe and secure transportation in supply chains are urgent issues in ASEAN countries

Table 4.1.13 Issues and Needs on Sediment Disasters

Issues and Needs	Country									
	Brunei	Cambodia	Indonesia	Lao PDR	Malaysia	Myanmar	Philippines	Singapore	Thailand	Vietnam
1. Development/improvement of sediment disaster hazard maps for countermeasure plan, land-use plan, and evacuation plan	-	-	*	O	*	O	*	-	*	*
2. Development of monitoring and early warning system including analysis technology	-	-	O	O	*	O	*	-	*	O
3. Introduction and upgrading of proactive structural measure for sediment disaster	-	-	O	O	*	O	O	-	O	O
4. Sediment disaster prevention planning in economic corridors to develop a safe/secure transportation	-	-	O	O	-	O	*	-	O	O
5. CBDRM for sediment disaster	-	-	*	O	*	O	*	-	*	O

Source: JICA Study Team
Note: 'O': Issues/Needs identified; '*': Available at present, to be enhanced/improved; '-': Issues/Needs not particularly relevant

The challenges and needs on sediment disaster management in ASEAN countries are summarized in Table 4.1.13.

Table 4.1.14 List of Draft Cooperation Project for Sediment Disaster Management

Country	Project
Indonesia	- Study on comprehensive sediment disaster management plan in strategic priority areas
Loa PDR	- Development of the road disaster prevention plan for the economic corridor and capacity development for road maintenance and management sector.
Malaysia	- Study on sediment disaster management plan in Kundasang (Kota Kinabalu) of Sabah district, Uluk Klang of Selangor district, and Cameron Highlands of Pahang district
Myanmar	- Study on sediment disaster management in mountainous areas including CBDRM
Philippines	- Study on the comprehensive sediment disaster management plan
Thailand	- Study on the development of sediment disaster monitoring and effective utilization of SABO technology
Vietnam	- Study on basic sediment disaster management plan

Source: JICA Study Team

a) Indonesia: Study on comprehensive sediment disaster management plan in strategic priority areas

Indonesia is one of the most sediment disaster prone countries in ASEAN region. The hazard maps were developed in some landslide and debris flow prone areas, and CBDRM for sediment disaster has been implemented in collaboration with JICA in some area. The disaster management composed of risk assessment, planning and implementing countermeasure, early warning and etc has not been implemented systematically. Thus, the JICA Study Team recommends the above mentioned study.

b) Lao PDR: Development of road disaster prevention plan on the economic corridor and capacity development for road maintenance and management sector.

The following are the three needs to strengthen the capacity of road management and to prevent road disasters; 1) Strengthening management capacity for sediment disaster risk reduction, 2) Improvement of countermeasures against large scale landslides, and 3) Development of early warning system for road disaster.

c) Malaysia: Study on comprehensive sediment disaster management plan in Kundasang (Kota Kinabalu) of Sabah district, Uluk Klang of Selangor district, and Cameron Highlands of Pahang district

Minerals and Geoscience Department Malaysia (JMG) raised the issues of sediment disasters in the above three areas. Though much direct information has not been made available, the Team considers the implementing the above mentioned study will provide advanced technology of Japan on sediment disaster management to Malaysia.

d) Myanmar: Study on comprehensive sediment disaster management in mountainous areas including CBDRM

There is a need to conduct countermeasures including early warning against sediment disasters in the mountainous area. The Asian Highway AH-1 that passes through Myanmar from Thailand to Bangladesh and India traverses a mountainous area where sediment disaster occurs. There is a need to improve the maintenance and management capacity of the road administrator.

e) Philippines: Study on the comprehensive sediment disaster management plan

The Mines and Geosciences Bureau (MGB) has developed a sediment disaster hazard map and conducted workshop and evacuation drill in areas susceptible to disasters. Consequently, it enlightened the community on disaster prevention. However, accuracy of the sediment disaster hazard map is so low due to small-scale base topographic map, which is not applicable for establishing a disaster prevention plan and evacuation plan. Monitoring system including early warning system has yet to be developed. Moreover, proactive countermeasures have not been constructed in disaster areas and thus, the main response is rehabilitation after disaster occurrence. There is a need to formulate a comprehensive sediment disaster prevention plan, where priority orders of areas susceptible to sediment disasters are decided based on the existing risk assessment. Based on the plan, improvement of the hazard map and implementation of structural and non-structural measures need to be conducted economically and effectively.

f) Thailand: Study on the development of sediment disaster monitoring and effective utilization of SABO technology

The CBDRM has been actively conducted in many communities in the mountainous areas. There are two needs to strengthen the sediment disaster management, namely, 1) Improvement of the existing monitoring system by introducing automatic observation instruments such as rainfall and river level gauge, and developing the criteria based on correlation between rainfall intensity and disaster occurrence; 2) Introduction of advanced technology on debris flow detection censor and countermeasures against the debris flow and landslides.

g) Vietnam: Study on basic sediment disaster management plan

Not much information was made available in Vietnam regarding sediment disaster management. SATREPS conducted research on disaster management in the central Vietnam. The Team considers that such assistance should be extended to other sediment disaster prone areas in Vietnam. The Study proposed will identify sediment disaster prone areas and prioritize such areas for implementation of disaster management projects.

4.1.3 Disaster Management, Early Warning and Disaster Education

The HFA-3 states that stakeholders need to use knowledge, innovation, and education to build a culture of safety and resilience at all levels. This section describes an overview of the current situation and challenges of each ASEAN country about disaster management information system and education for disaster prevention and mitigation.

(1) Knowledge Management - Disaster Management Information System (DMIS)

The DMIS is a system that supports disaster management planning and decision making effectively and timely for preparedness, emergency response, and recovery activities. Disaster management agencies should accumulate historical disaster data for conducting risk assessment in a normal situation. During emergency situations, such agencies shall issue early warning, order evacuation, conduct search and rescue, and other activities needed based on the monitoring results. At the same time, information on damage, disaster response, necessary support, and others will have to be collected and integrated through a disaster management information system. The information will also be shared among relevant agencies.

The present situation of DMIS, disaster loss database and early warning system are shown in Table 4.1.15.

Table 4.1.15 Present Situation of DMIS and Early Warning System

Information System on Disaster Management		Country									
		Brunei	Cambodia	Indonesia	Lao PDR	Malaysia	Myanmar	Philippines	Singapore	Thailand	Vietnam
DMIS		*n/a*	*u/c*	O	*u/c*	O	*n/a*	O	O	*n/a*	*n/a*
Disaster Loss Database		*n/a*[*1]	*u/c*	O	*u/c*	*n/a*	*n/a*	O	*n/r*[*4]	*n/a*	O[*6]
Early Warning System	Flood	O	O	O	O	O	O	O	O	O	O
	Flash Flood	*n/a*	*n/a*	*n/a*	O	*d-n/a*	*d-n/a*	*n/a*	*n/r*	*n/a*	-p
	Typhoon/Cyclone	O	*n/a*	O	O	O	O	O	*n/r*	O	O
	Landslide	*n/a*	*n/a*	O	*n/a*	*n/a*	*n/a*	*d-n/a*	*n/r*	O	-p
	Tsunami	*n/a*	*n/a*	O	*n/r*	O	O	O	O	O	O[*5]
	Volcano (ash monitoring included)	*n/r*	*n/r*	O	*n/r*	O	*n/r*	O	O	*n/r*	*n/r*
	Severe weather[*2]	O	O	O	O	O	O	O	O	O	O
	Rough Sea	O[*3]	*d-n/a*	O	*n/r*	*d-n/a*	*d-n/a*	*d-n/a*	*d-n/a*	*d-n/a*	*d-n/a*
	Drought	*d-n/a*	*d-n/a*	*d-n/a*	*d-n/a*	O	*d-n/a*	*d-n/a*	*d-n/a*	O	*d-n/a*
	Haze	*d-n/a*	*d-n/a*	*d-n/a*	*d-n/a*	O	*d-n/a*	*d-n/a*	O	*d-n/a*	*d-n/a*
	Storm Surge	*d-n/a*	*d-n/a*	*d-n/a*	*n/r*	*d-n/a*	O	*d-n/a*	*d-n/a*	*d-n/a*	*d-n/a*

Source: JICA Study Team (2012), National Progress Report on the Implementation of the Hyogo Framework for Action (2007-2009, 2009-2011)

Note: *1: Disaster losses are systematically reported, monitored and analyzed; *2: Heavy rain, Strong wind; *3: strong wind, tropical storm; *4: A disaster loss database for natural disaster is not needed because a large disaster has not occurred so far; *5: Tsunami EWS has been established only in Da Nang; *6: The database has information on main disasters since 1989, but CCFSC maintains records for much longer but only on hard-copies;

Legend: 'O': available; '*n/a*': not available; "*u/c*": under construction; "*n/r*": not relevant; *d-n/a*: data not available; -p: pilot project only

According to the above information, the following are considered as issues and needs for cooperation.

Table 4.1.16 Issues and Needs for DMIS[5]

Issues and Needs	Country	Bilateral/ ASEAN Regional Cooperation
Development of Disaster Management Information System	Brunei Myanmar Philippines*a (Thailand)*b Vietnam	1. Bilateral cooperation - Development of disaster management information system based on GIS. 2. ASEAN cooperation - (proposed in the other section called "ADMIS")
Development of DMIS	Brunei (Malaysia)*b Myanmar Vietnam	1. Bilateral cooperation - Establishment of a mechanism for collecting and accumulating disaster loss data. - Development of disaster loss database and sharing system. 2. ASEAN cooperation - Improvement of ASEAN DRR Portal and accumulating disaster loss data of each county. (Lead organization: ASEAN Secretariat and/or AHA Centre) - Development of disaster loss database and sharing system for ASEAN Region. (Lead organization: AHA Centre)

Source: JICA Study Team

Note: *a: Available DMIS is not GIS basis; *b: The countries are considered to be capable to establish it by herself.

(2) Education for Disaster Prevention and Mitigation

Disaster education is necessary to raise people's awareness on disaster management in general. Knowledge on disasters such as scientific information, simulating earthquake intensities by shaking tables, and evacuation drills should be practiced in schools, communities, and private sectors. It is important to know how to respond to disaster in order to save own lives during its occurrence. Moreover, it is also important to promote cooperation during emergency cases as a family or community unit, in order to achieve possible evacuation support, maintain evacuation sites, manage social safety, and so on.

School education serves as basic public disaster education. In order to promote school education on disaster management, education system needs to be developed systematically such as enhancement of school curriculum, textbooks, and other necessary materials.

Several ASEAN countries already prepared these education materials including pamphlets, posters, and videos. NGOs are supporting the preparation of education materials and community education.

For effective disaster education, the following items will be developed:

a) Teaching guidelines and teacher's training,
b) Education materials according to grade level,
c) Disaster simulator for earthquake, and smoke/fire extinguisher training, and
d) Regular disaster drill in schools.

5 All the views are attributed to JICA Study Team.

In addition to school disaster education, community education is also necessary based on CBDRM. Interchange of disaster knowledge and sharing information among communities are key items for community disaster education. Local governments should promote community disaster education in cooperation with NGOs.

Private sectors also need to conduct disaster management education and training for employees to protect or minimize damage. Based on the regional disaster management plan or governmental regulations, private sectors need to prepare emergency management plan by themselves. Regular drill for emergency management should also be conducted regularly.

According to the above information concerning Disaster Management Information System (DMIS), obtained through survey, the following are considered to be issues and needs for cooperation.

Table 4.1.17 Issues and Needs for Education on Disaster Prediction and Mitigation[6]

Issues and Needs	Country	Bilateral/ ASEAN Regional Cooperation
(1) Enhancement of School Education	Cambodia Myanmar Vietnam	(1) Bilateral cooperation - Development of teaching guidelines and teacher's training. - Development of teaching materials according to grade level. - Development of disaster simulator for earthquake, and smoke/fire extinguisher training. - Regular disaster drill at school. - Development of education material databases. (2) ASEAN cooperation - Improvement of ASEAN DRR Portal and accumulating disaster loss data of each county. (Lead organization: ASEAN Secretariat and/or AHA Centre)
(2) Enhancement of Disaster Education for CBDRM	Brunei Cambodia Indonesia Lao PDR Philippines Vietnam	(1) Bilateral cooperation - Assistance of CBDRM (e.g., evacuation drills, community based hazard mapping, building shelter management system and evacuation plans, improvement of early warning system, formulation of community disaster manual and awareness plan) - Development of guidelines on how to conduct CBDRM. - Development for knowledge sharing mechanism among communities. - Capacity building for implementing CBDRM
(3) Enhancement of Disaster Education for Private Sectors	All ASEAN countries	(1) ASEAN cooperation - Creation of BCP guide line for private sector. - Creation of BCP guide line for regional industrial clusters

Source: JICA Study Team

4.1.4 Preparedness for Effective Response

(1) Needs for Early Warning System

Early warnings are issued by agencies who conduct monitoring or by disaster management agencies (or coordinating agencies). In any case, routes/means that transmit disaster information within most of administrative agencies at various levels have been established.

6 All the views are attributed to the JICA Study Team.

However, the information routes from administrative agencies to public/communities have not necessarily been established. Table 4.1.18 shows the present situation of the availability of early warning mechanism.

Table 4.1.18 Present Situation of Early Warning

	Information flow		Country									
	From	To	Brunei	Cambodia	Indonesia	Lao PDR	Malaysia	Myanmar	Philippines	Singapore	Thailand	Vietnam
Means of warning dissemination (Availability of procedural guidelines, facilities/equipment, mechanism)	Monitoring Agency	Decision making agencies at National level and local level	O a	u/c a	O a	O a	O a	tel a	O a	O a	O a	O a
	Decision making agency	Local government										
	Local government	Communities under impending hazard	* a,b	* a	O b	* a	O a	* a,b	O b	O a	O a	* a

Notes: O: Available for operation; *: Partially available/limited function; u/c: Under construction; tel: Public telephone line only

Source: a: Interview by the Study Team, b: National Progress Report on the Implementation of the Hyogo Framework for Action (2007-2009, 2009-2011)

The main route/means of disseminating warning information to public are the mass media (television, radio, newspapers), internet (social networking websites), and the like. In some ASEAN countries, natural hazard prone communities do not receive timely and/or understandable warnings on impending hazard events. There is, thus, a common challenge/need that public should be informed of an impending hazard or be given proper information in order for them to determine whether they should evacuate or not.

Early warning systems by administrative offices issued to public other than mass media need to be installed/improved in order to realize an end to end warning dissemination to risk prone communities[7]. The early warning systems should include procedural guidelines[8], facilities/ equipment, staffing, and so on.

Table 4.1.19 Needs for Early Warning

Country	Needs
Brunei[9], Cambodia[10], Lao PDR[11], Myanmar[12] Vietnam[13]	- Development means of early warning (procedural guidelines and/or facilities/equipment, mechanism) , from government agencies to communities; - Implementation of CBDRM

Source: JICA Study Team

[7] There are means of dissemination by local staffs riding motorbikes or bicycles with loudspeakers, bells, drums, and speakers of religious facilities, etc.
[8] Including criteria for the decisions to issue evacuation orders
[9] According to interview survey to Tutong District Office by the JICA Study Team (2012)
[10] Interview survey to NCDM (Cambodia) by the JICA Study Team
[11] Proposed by the JICA Study Team based on the interview with MDMO (Lao PDR)
[12] Proposed by the JICA Study Team based on the interview with MDPA (Myanmar)
[13] Proposed by the JICA Study Team based on the interview with DDMFSC (Vietnam)

Recently, possibly due to the prevailing climate change, flash floods occur more frequently in various areas in the world. This is also an impending issue for disaster management. Efforts have been made in various countries to predict such flash floods, though needs to be established firmly. Concurrently, with the efforts for prediction, effective and timely early warning systems should be established for flash floods.

It has also been identified that there will be significant scales of earthquakes that could happen at ocean trenches of western and southwestern islands of the Philippines. Such earthquakes are considered to trigger considerable scale of tsunamis that may reach surrounding countries like the Philippines, Malaysia (Saba, Sarawak), Brunei, Indonesia, and Vietnam facing South China Sea, Sulu Sea, and Celebs Sea.

- A concentrated research on earthquake and tsunami, hazard mapping, and so on needs to be conducted.
- At the same time, tsunami early warning systems should be installed in those coastal areas together with formulation of (tsunami) disaster management plan including public awareness programs, evacuation exercises and so on.

(2) Disaster Preparedness

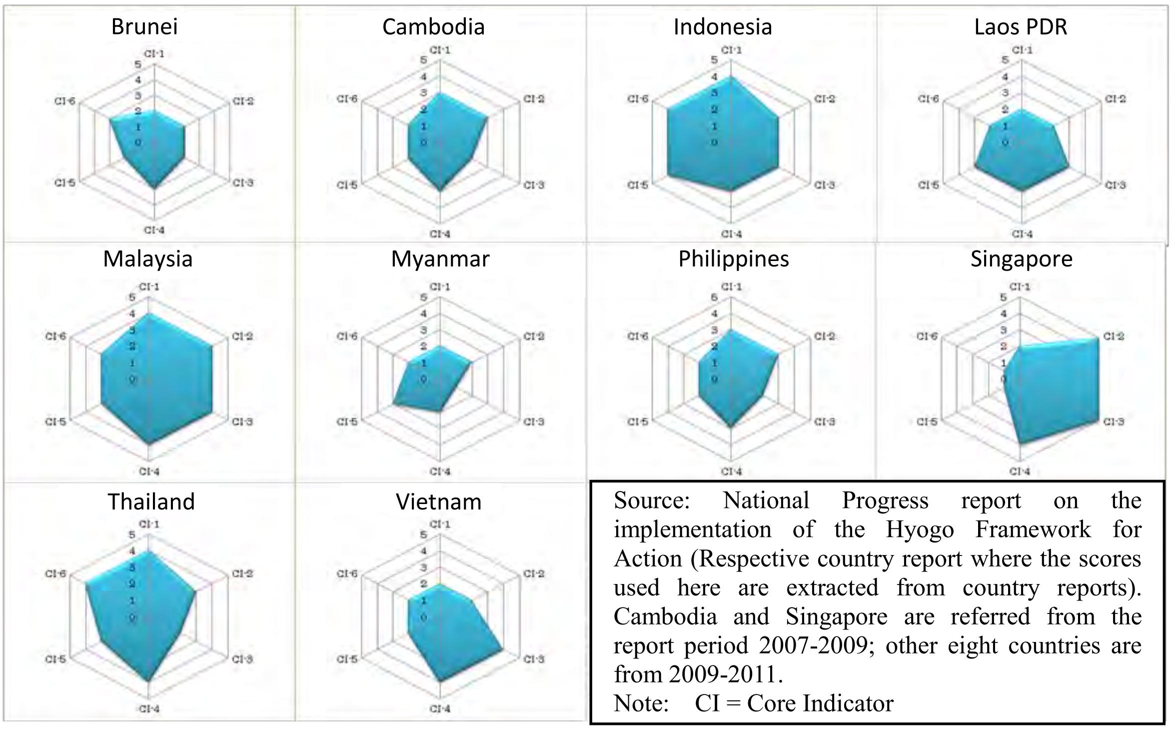
There are six core indicators proposed and used for HFA concerning "reduce the underlying risk factors".

Table 4.1.20 Core Indicators of HFA 4: "Reduce the Underlying Risk Factors"

Core Indicator 1	Disaster risk reduction is an integral objective of the environment-related policies and plans, including for land use, natural resource management and climate change adaptation.
Core Indicator 2	Social development policies and plans are being implemented to reduce the vulnerability of populations most at risk.
Core Indicator 3	Economic and productive sectoral policies and plans have been implemented to reduce the vulnerability of economic activities.
Core Indicator 4	Planning and management of human settlements incorporate disaster risk reduction elements, including enforcement of building codes.
Core Indicator 5	Disaster risk reduction measures are integrated into post-disaster recovery and rehabilitation processes.
Core Indicator 6	Procedures are in place to assess disaster risk impacts of all major development projects, especially infrastructure.

Source: UNISDR, Indicators of Progress: Guidance on Measuring the Reduction of Disaster Risks and the Implementation of the Hyogo Framework for Action, 2008.

Figure 4.1.1 enumerates the evaluated results of HFA 4 core indicators of 10 ASEAN countries.



Source: National Progress report on the implementation of the Hyogo Framework for Action (Respective country report where the scores used here are extracted from country reports). Cambodia and Singapore are referred from the report period 2007-2009; other eight countries are from 2009-2011.
Note: CI = Core Indicator

Figure 4.1.1 Results of Grading HFA 4 Core Indicators by 10 ASEAN Countries

Glancing over above Figure 4.1.1 provides an idea on what indicators are better or worse for certain countries. Indonesia, Malaysia, and Thailand are largely high standing. Some indicators, however, are not so relevant for some countries which resulted in fewer score as progress in such indicators are not necessarily required or urgent (e.g., core indicators 1, 2, 3 and 5 for Brunei, and core indicators 5 and 6 for Singapore). Table 4.1.21 shows indicator by issues in relevant countries (principally countries graded 2 or below were chosen), which gives ideas on necessary assistance.

Table 4.1.21 Issues by HFA 4 Core Indicators: 10 ASEAN Countries

Core Indicator 1	(1) Lao PDR: Pervasiveness of “Environmental Impact Assessment” (2) Myanmar: Development of “Environmental Impact Assessment” Framework (3) Vietnam: Incorporation of Disaster Risk Assessment into “Environmental Impact Assessment” Guideline
Core Indicator 2	(1) Lao PDR: Mobilization of resources to conduct “Social Safety Net” activities (2) Myanmar: Widening the targeted areas to implement social development programs (3) Vietnam: Mobilization of recovery fund and widening of disaster insurance options
Core Indicator 3	(1) Cambodia: Prevalence of disaster risk reduction within the economic sector (2) Myanmar: Formulation of policy in economic and productive sectors (3) Philippines: Creation of reinsurance facilities as a risk transfer mechanism (4) Thailand: Adaptation of disaster risk reduction in productive sector (except for agriculture sector)
Core Indicator 4	(1) Myanmar: Conduct of comprehensive multi-hazard assessment, incorporating human settlements and urban planning process
Core Indicator 5	(1) Cambodia: Integration of disaster risk reduction and post disaster recovery and rehabilitation into a strategy (2) Philippines: Making recovery planning process to be proactive (3) Vietnam: Resource mobilization for recovery and reconstruction
Core Indicator 6	(1) Cambodia: Adding practical experience in the procedure of disaster risk impact assessment (2) Lao PDR: Development of technical capacity and expertise in Environment and Social Impact Assessment (3) Myanmar: Creation of assessment framework for disaster impact, especially at the community level.

Source: National Progress Report on the Implementation of the Hyogo Framework for Action (Respective country report where above the information is extracted from). Also see the note under Table 4.1.6.<2>.

(3) Preparedness for Emergency Response

Table 4.1.22 below enumerates ten ASEAN countries with their respective conditions on preparedness for emergency response from the view point of planning, funding, operation/procedure Standard Operating Procedure (SOP), and disaster drill.

Table 4.1.22 Preparedness for Emergency Response: 10 ASEAN Countries

Country	Contingency Plan	Funding	Operation/Procedure	Disaster drill
Brunei	-	O	O (Waiting for new SOP to be approved within 2012)	O (Conducted in 24 districts)
Cambodia	Expected to be approved within 2012)	O	Expected to have a mechanism of implementation	Donor led
Indonesia	O (20-30 Districts/ cities have prepared)	O	O (Procedures are limited to national level)	O
Lao PDR	Expected to be revised, while it is still limited to flood	O (not enough)	Expected to revise SOP and contingency plan	Donor led
Malaysia	-	O	O (i.e., Seven SOPs)	O
Myanmar	O (Standing order)	O (not enough)	O (i.e., Standing order)	O
Philippines	Expected to prepare plan covering multiple hazards	O	Expected to prepare SOP	O (Coverage unknown)
Singapore	O	O	O	O
Thailand	Expected to formulate new one, reflecting the lessons from 2011 flood.	O	O	O
Vietnam	O (It is formulated every year up to the commune level)	O (not enough)	-	Model activity to be rolled out.

Source: JICA Study Team

Note: O: Available

Overview of the contingency plans across 10 ASEAN countries indicates the following needs.

a) Plans need to be extended to cope with multiple disasters[14]: Lao PDR, the Philippines, and Vietnam; and
b) Capacity development to gain expertise[15]: Cambodia, Lao PDR, Myanmar, and the Philippines.

As for the operation/procedure for emergency response, certain needs are observed as follows:

a) Establishment of operation mechanism[16]: Cambodia, Lao PDR, and the Philippines; and
b) Preparation of SOP[17]: Lao PDR, the Philippines, and Vietnam.

4.2 Aid Projects Identified

4.2.1 Integrated Disaster Management Plan for Megacities in the ASEAN Region

In the ASEAN region, there are megacities having more than 10 million populations such as Bangkok, Ho Chi Min, Jakarta, and Manila. Other big cities are Davao, Hanoi, Kuala Lumpur, Surabaya, and Yangon. These cities are located mainly in the coastal lowland areas except for Kuala Lumpur. Such coastal lowland areas are relatively subject to high risks such as flood, earthquake, tsunami, and storm surge. Effects of climate change will also cause adverse impact on sea level rise, coastal erosion, rainfall intensity, and storm occurrence. Possible hazards to the ten capital cities and other major cities are listed in the table below.

Among the megacities, Jakarta, Yangon, Manila and Bangkok should be highlighted from multi-hazard point of view.

In **Jakarta**, accumulation of social and economic infrastructure is so huge at present. Java Island is located in an earthquake prone area; however, detailed earthquake damage estimation and disaster management plan have not been prepared yet. In order to avoid or minimize earthquake disaster damage, earthquake disaster management plan shall at least be prepared at the soonest. Flooding is also a long lasting issue of this city. Rapid urbanization including excessive groundwater extraction ground subsidence has led to frequent and severe flooding, resulting in frequent disruption of capital functions. A comprehensive and integrated disaster management plan will therefore be needed. This is also necessary for risk management of business continuity with international investors.

Yangon is one of the hottest cities in the world in terms of economic investment. It is expected that its present population of 6 million will increase to 12 million by year 2030. Rapid urbanization will be unavoidable. It is understood that development master plan studies are in the pipe lines for urban development plan, water supply and drainage plan and plan for transportation sector. These master plan studies will incorporate factors of possible natural hazards. However, because Yangon is exposed to various types of hazard such as

[14] The need is identified by the JICA Study Team, while the Philippines identified its own need.
[15] The need is identified by the JICA Study Team.
[16] The need is identified by the JICA Study Team.
[17] The need is identified by Lao PDR and the Philippines, while the JICA Study Team identified the needs of Vietnam.

earthquake/tsunami originated by the Sagaing active fault, urban type floods prevailing even now, and storm surge such as Cyclone Nargis, comprehensive and integrated disaster management plan is considered to be indispensable, based on scientific hazard identification, risk and impact assessments.

In **Manila**, urbanization of its metropolitan area has extended to the north and south. Population of Mega Manila will soon reach 25 million including Bulacan, Marikina, Laguna, Rizal, and Cavite. Under this circumstance, the existing earthquake disaster management plan needs to be reviewed and updated based on recent statistics. Also, surrounding urbanized areas of Metropolitan Manila need to be included in this review. It is noted that Manila suffered from strong typhoon causing big flood disasters in 2009 and 2011, including the one caused by Typhoon Ondoy in 2009, which is compounded with storm surge. Flood disaster management is also important and necessary, especially in Metropolitan Manila. Although it is understood that a study on urban flood management in Metropolitan Manila is being conducted, a comprehensive and integrated disaster risk reduction management plan will be needed, taking into consideration the above-mentioned complexity caused by multi-hazard risks.

In **Bangkok**, after experiencing huge flood disaster in 2011, various disaster management plans for flood risk management are being prepared. However, it is also understood that the ground subsidence being caused by groundwater extraction has worsened the situation. Further, storm surge in coastal area has become a main challenging issue in addition to the risk from tsunami. Under this circumstance, comprehensive and integrated disaster risk reduction management will be needed as well for Bangkok.

Table 4.2.1 Hazard Prone Capital Cities and Large Cities
- Needs for Multi-Hazard Integrated Disaster Risk Management Plan-

Country	Mega-city/ Big City	Potentiality of Sever Hazards					Needs of Multi-hazard I-DRMP*	Needs Raised by the Institutions
		Earth -quake	Tsunami	Flood	Storm Surge	Volcano		
Brunei	Bandar Sri Begawan	-	O	O	-	-	-	NDMC
Cambodia	Phonon Penh	-	-	OO	-	-	-	Study Team
Indonesia	**Jakarta**	**OO**	**OO**	**OO**	-	**O**	☑☑	BPBD/DKI-JKT
	Surabaya	O	O	OO	-	O	☑	Study Team
Lao PDR	Vientiane	-	-	OO	-	-	-	MPWT
Malaysia	Kuala Lumpur	-	-	OO	-	-	-	DID
Myanmar	**Yangon**	**OO**	**O**	**OO**	**OO**	-	☑☑	YCDC
	Naypyidaw	**OO**	-	-	-	-	-	MES/MGS
Philippines	**Manila**	**OO**	**OO**	**OO**	**OO**	**O**	☑☑	MMDA
	Davao	OO	OO	OO	OO	O	☑	Study Team
Singapore	Singapore	-	-	-	-	-	-	-
Thailand	**Bangkok**	-	-	**OO**	**O**	-	☑☑	Study Team
Viet Nam	Ho Chi Min	-	O	OO	O	-	☑	DDMFSC
	Hanoi	O	-	OO	-	-	☑	DDMFSC

OO: High potential , O: Potential, -: Low potential (Source: JICA Study Team)
☑☑: Urgently required, ☑:Required, -: Not required
*) I-DRMP: Integrated Disaster Risk Management Plan

4.2.2 ASEAN Disaster Management – Satellite Imagery Analysis Technology Centre[18]

(1) Background

Satellite imagery is being utilized for quick assessment of situations soon after regional disasters occur. A mechanism of Sentinel Asia was established in 2006 to assist in disaster management of Asian countries. Under the mechanism, the countries who own satellites provide satellite information to other countries without satellites, on demand when disasters occur. It is reported that in the case of the flood of 2011 in Thailand, it analyzed satellite information provided through Sentinel Asia and successfully estimated/counted affected houses in the flooded area. It was also reported that satellite information was utilized effectively in the case of the Great East Japan Earthquake in March 2011.

The AHA Centre has recently joined the 'Sentinel Asia' as part of the Joint Project Team and is able to receive satellite information/imagery of the ASEAN member states. On the other hand, in order to utilize satellite information, analysis and/or visualization techniques of raw data are necessary together with facilities for the utilization of satellite information. Seven ASEAN countries[19] are registered as Data Analysis Nodes (DAN), who are in charge of data analysis when requested.

In order to facilitate quickest coordination when disasters occur, the AHA Centre shall have disaster information as soon as possible. For this reason, the centre shall be desired to possess its own capabilities for analyzing satellite information. Further, the future step will be for AHA Centre to have its own receiving antenna, consequently allowing it to receive raw data directly from earth observation satellites (EOS) whenever necessary.

(2) Effective Use of Satellite Imagery

1) Present operation mechanism – Sentinel Asia

The following mechanisms have been established through Sentinel Asia:

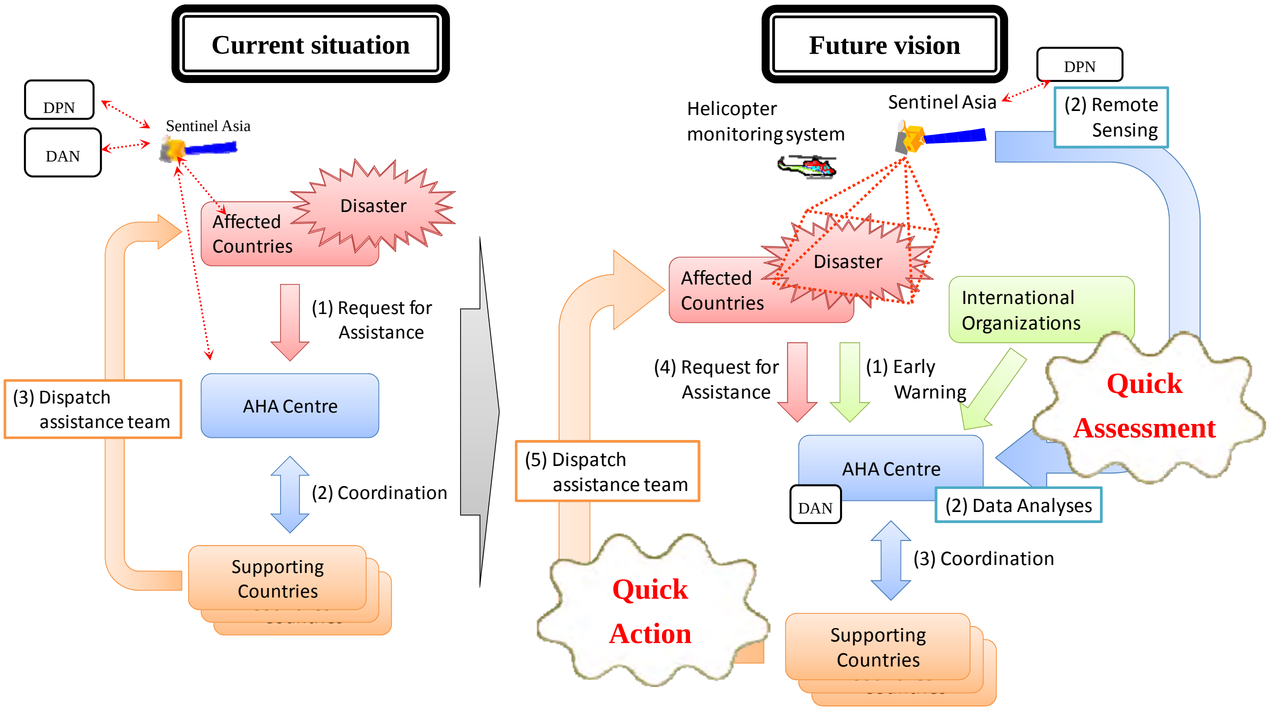
a) Disaster struck member countries to request the Sentinel Asia for satellite images of disaster struck areas;
b) Sentinel Asia to request satellite data providers (called as Data Provider Nodes) for satellite images (raw digital information) concerned;
c) The "Data Analysis Nodes" of member organizations to analyze the raw digital information for conversion into analysed visible images (value added images); and
d) Sentinel Asia to send the value-added images to disaster struck members who requested such information.

2) Recommendation for speedy data utilization

Above-mentioned steps are required for any disaster-affected member country or AHA Centre to finally obtain analysed visible images. If AHA Centre should conduct all the steps above, a quicker impact assessment would become possible, enabling speedy response and relief

18 This issue was proposed by the JICA Study Team (2012).
19 Brunei, Indonesia, Malaysia, Philippines, Singapore, Thailand, and Vietnam as of July2011.
(http://www.jaxa.jp/press/2011/07/20110727_sac_sentinel.pdf)

activities on disasters in member countries. An image of operation mode of current situation and future vision is shown below.



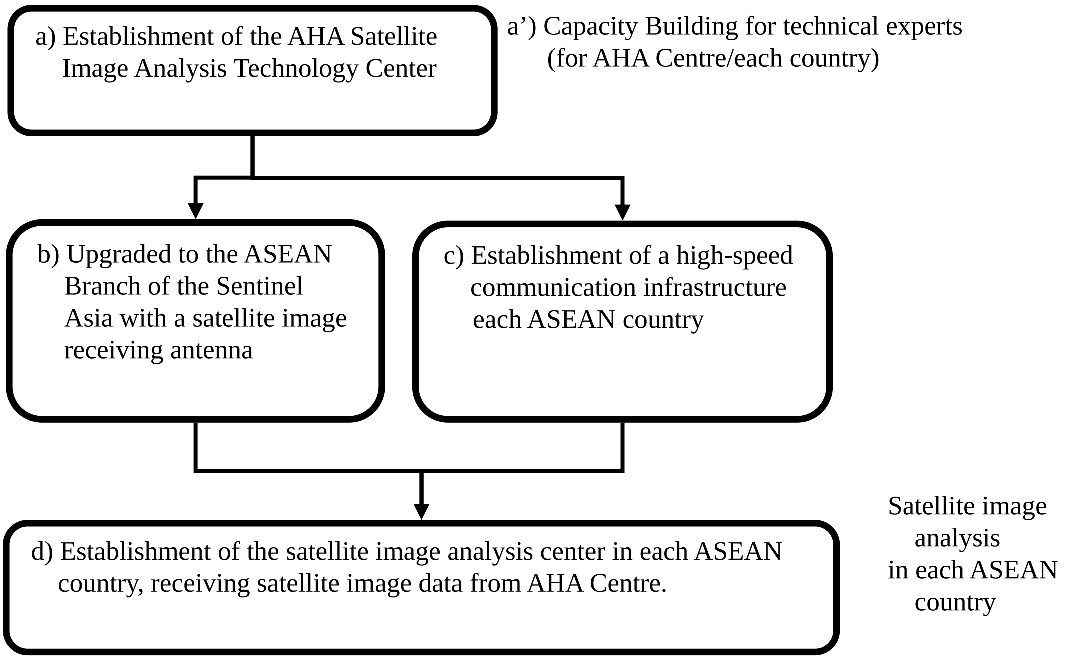
Source: JICA Study Team

Figure 4.2.1 Comparison between Current Situation and Future Vision on ASEAN Regional Support

Further, if each ASEAN country would have the capacity to analyse raw digital information taken by satellites, the operation speed of hazard assessment could be maximized.

(3) Recommended Steps to be Taken

Recommended steps for realization of the above mentioned concept is shown in Table 4.2.2 and are also illustrated in Figure 4.2.2.



Notes: Item codes (a) – (d) corresponds to the codes in the table below
Source: JICA Study Team (2012)

Figure 4.2.2 Recommended Flow of Steps to be Taken

Table 4.2.2 Establishment of the AHA Satellite Image Analysis Technology Centre

Establishment of the AHA Satellite Image Analysis Technology Centre				
Items			AHA Centre	Each ASEAN Country
1st Step	~3 years	a) Establishment of the "AHA Satellite Image Analysis Technology Center" for image analysis. Capacity Building for technical experts of AHA Centre.	O	
		a') Capacity building for technical experts in each ASEAN country at AHA Centre		O
2nd Step	~5 years	b) Establishment of the "ASEAN Branch Office" of the Sentinel Asia with a newly constructed image receiving antenna for direct receiving of image; for image analysis, training of AHA Centre.	O	
		a') Capacity building for technical experts in each ASEAN country at the ASEAN Branch of the Sentinel Asia		O
		c) Development of communication infrastructures between AHA Centre and ASEAN countries for transmitting images		O
3rd Step	~10 years	a') Capacity building for technical experts in each ASEAN country at the ASEAN Branch of the Sentinel Asia (tentative name).		O
		d) Establishment of the satellite image analysis center on the Sentinel Asia in each ASEAN country		O (if required)

Notes: item codes (a) – (d) corresponds to the codes in the figure above
Source: JICA Study Team (2012)

(4) Input Needed

The following inputs will be required for the establishment of the AHA Satellite Image Analysis Technology Center:

Table 4.2.3 Inputs Required for the Establishment of the AHA Satellite Image Analysis Technology Center

Step	Goal	Input required
First Step	To introduce satellite image analysis technology to the AHA Centre	a. Provide equipment for data analysis and relevant computer software b. Dispatch experts on satellite image analysis to AHA Centre (a number of short period assignment) c. Invite experts from ASEAN member countries for training on satellite image analysis (a number of short period training) d. Employ experts to AHA Centre who are in charge of satellite image analysis
Second Step	For the AHA Centre to upgrade to "ASEAN Branch of Sentinel Asia" with own satellite data receiving antenna	a. Expand/enforce the function of the the satellite image analysis center b. Construct a data receiving antenna and provide necessary equipment c. Continue training to AHA Centre and the ASEAN member countries
	For ten ASEAN member states to be connected with high-speed communication infrastructure	a. Provide high-speed communication infrastructure connecting the ten ASEAN countries, and necessary capacity building and training
Third Step (in future)	To establish the satellite image analysis center in each ASEAN state, receiving satellite image data from AHA Centre	(as required)

Source: JICA Study Team

4.2.3 Natural Disaster Risk Assessment and Formulation of BCP for Regional Industrial Clusters[20]

(1) Background

Flood disasters in 2011 had caused serious and historical damages to ASEAN countries. In particular, the flooding of the Chao Phraya River of Thailand has not only caused direct economic losses of USD 45.7 billion[21] to firms in industrial parks and clusters of Thailand, but also indirectly and considerably affected economies of other ASEAN member countries and Japan, who are closely linked through networks of supply chains.

As a result, the flood disaster forced industries engaged in electronics, automotive parts, machinery parts, and others to shut down, which adversely affected the worldwide production of related businesses such as automotive industries, for a long period. According to the Office

[20] This subject was presented by the Study Team to the representative from ten ASEAN countries at the workshop held on 11 June 2011 in Jakarta

[21] According to the estimation of the World Bank as of December 2011

of Insurance Commission, insured losses from the floods in Thailand 2011 were expected to be in excess of USD 10.8 billion[22], which would be further adjusted in the final loss figures. Consequently, they were forced to withdraw from the affected areas or revise their terms and conditions, causing investors/industries to be hesitant in continuing their activities in the affected areas.

From the experiences of the Chao Phraya River flood in 2011, it was reaffirmed that natural disasters will have severe and adverse impacts not only on humanitarian aspects but also on national and inter-regional nations, as well as worldwide economy. It has also been recognized that against such huge natural disasters, efforts by individual firm/factory will experience limited effects. Therefore, an approach where industrial park/cluster acting as one unit of economic body, will have to be taken into consideration for disaster management.

Under such circumstance, formulation of business continuity plan (BCP)[23] is indispensable for each regional industrial cluster based on scientific risk assessment to minimize economic losses/damages resulting from natural disasters.

(2) Purpose

a) To conduct natural disaster risk assessment for industrial clusters in the ASEAN region,
b) To formulate a BCP for the target industrial cluster based on risk assessment, and
c) To propose an ASEAN standard procedure for natural disaster risk assessment, and formulate business continuity plan for industrial clusters.

(3) Target Area for Research/Study

Industrial clusters in ASEAN member countries are to be nominated and selected through dialogues among relevant organizations.

(4) Contents/Outputs from Research/Study

The items for research and study are, but not limited to, the following shown in table below:

[22] As of December 2011: Office of Insurance Commission
[23] In a broad sense, it is called as "Incident Preparedness and Operational Continuity Management (IPOCM)"

Table 4.2.4 Draft Work Items – Bi-lateral Cooperation

Phase 1 Natural Disaster Risk Assessment	Phase 2 Regional BCP
1. Collect, organize analyze data of hazard, exposure, vulnerability, damage and others of identified natural disasters. Data collection of maps-information is also included. 2. Build a GIS database of natural disasters and socio-economic conditions. 3. Conduct hazard assessment and impact assessment of natural disasters; (1) Identification of hazard, risk and thread of flood, earthquake/tsunami, storm and others, (2) Estimation of direct and/or indirect economic damages/losses to industries and/or macro-economy, (3) Development of hazard maps according to various scenarios of hazard identified, and (4) Impact analysis 4. Assess impact on industries, supply chains and macro-economy. 5. Analyze and assess vulnerability and risk of facilities and/or properties susceptible to natural disasters.	6. BCP formulation (1) Prevention and mitigation programs (2) Response management programs (3) Emergency response management program (4) Continuity management program (5) Recovery management program (6) Risk transfer 7. Implementation and operation (1) Resources, roles, responsibility, and authority (2) Building and embedding BCP in the organization's culture (3) Competence, training, and awareness (4) Communication and warning (5) Operation control 8. Finance and administration 9. BCP performance assessment (1) System evaluation (2) Performance measurement and monitoring (3) Testing and exercise (4) Corrective and preventive action (5) Maintenance (6) Internal audits and self assessment 10. Management review （Items 6～10: after ISO/PAS 22399, except 6-（5）added by the Study Team）

Notes:

1) Indirect damages/losses (damages to industries and macro-economy) will have to be estimated from the viewpoint of ASEAN regional collaboration (Item 3. (2)), which necessitates a considerable period for comprehensive data collection and analysis.
2) Items 6 to 10 in Phase 2 defined as Regional BCP will be similar to comprehensive natural disaster management plan with a special emphasis on 'activity continuity'.
3) Accuracy of hazard maps and/or risk maps to be formulated will be subject to topographic maps (availability, scale and accuracy), accuracy of hazard analysis and others; those are largely dependent on volume of input from human resources and time. Accuracy of hazard maps will have therefore to be determined through an assessment of availability of resources to be input.
4) Items 7 -10 are standard items included in ISO procedures for sustaining the actual operation of the BCP.
5) Risk Transfer (6. (6)) is included by the Study Team in the plan is considered to be an essential alternative for risk management.

Source: JICA Study Team

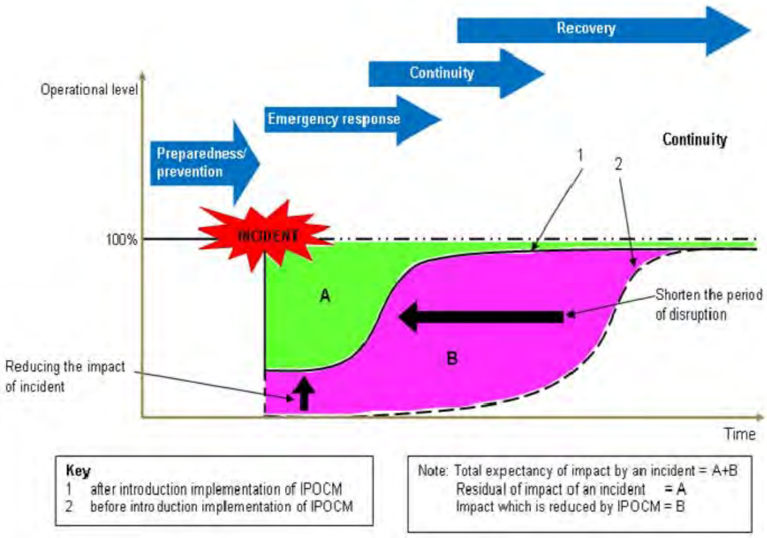
(5) Implementation Framework as ASEAN Regional Collaboration

Proposed implementation framework is shown in Table 4.2.5 below.

Table 4.2.5 Implementation Framework (Draft)

ASEAN Regional Collaboration (Input from ASEAN)	Bi-lateral Cooperation (Input from state where target industrial cluster will locate)
・ Coordination: AHA Centre ・ Panel of Experts: Disaster related-organizations/institution in ASEAN region: ➢ ASEAN Secretariat[note-1] ➢ Researching/academic institutions[Note-2]	・ Counterpart agency: a government entity in charge of industrial clusters or the like, ・ Member of implementation committee: entity in charge of disaster management at national (such as NFP), and local levels where the target industrial clusters are located, and entities in charge of relevant disasters
Input from Japan	
・ Funding Agency: Japan International Cooperation Agency (JICA) ・ Technical Advisors: Researching /academic institutions/agency in Japan[Note-3] ・ Implementation: Consultants	
Examples of organization/institutions Note-1 : ASEAN Committee on Disaster Management（ACDM） Committee on Science and Technology (COST) Sub-committee on Meteorology and Geophysics Note-2: ASEAN Earthquake Modeling Group (Nanyang University, Singapore）, BMKG(Indonesia), PHIVOLCS (Philippines) Chulalongkorn University (Thailand) Asia Institute of Technology (Thailand) Southeast Asia Disaster Research Institute (SEADPRI-UKM) (Malaysia) LIPI, Indonesia University, ITB, Gadhja Mada University (Jogjakarta), Syiah Kuala University（Aceh）(Indonesia) Note-3: Tokyo University, Kyoto University, Tohoku University, I-Charm (Japan)	

Source: JICA Study Team



Source: ISO/PAS 22399, Societal security – Guideline for incident preparedness and operational continuity management

Figure 4.2.3 Concept of Disaster Preparedness and BCP

4.2.4 Earthquake and Tsunami Disaster Management in Member Countries Facing South China Sea, Sulu Sea, and Celebes Sea[24]

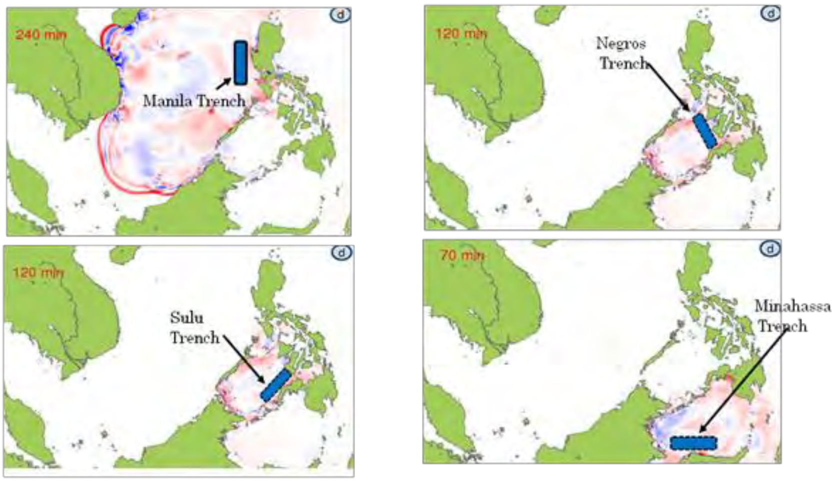
(1) Background

In the western offshore area of the Philippine Island, many trench structures are formed such as Manila Trench, Negros Trench, Sulu Trench, and Cotabato Trench. In the northern offshore area of Sulawesi Island in Indonesia, Minahasa Trench and Celebes Trench are distributed.

Out of these, USGS pointed out that there is a possibility of strong earthquake occurrence at M 8.5~9.0 in Manila Trench in near future. In case of occurrence of earthquake at this magnitude, not only an earthquake damage the Philippines, but also tsunami disaster will occur at the east central coast of Vietnam, Saba Sarawak area in Malaysia, and coastal area of Brunei. Other five trenches are also considered to be as possible sources of strong earthquakes accompanied with tsunamis.

Disaster management agencies of each country have already recognized the possibility of strong earthquake and tsunami originating in Manila Trench. The coastal area of the central Vietnam is beach resort areas having a world heritage. Similarly, the coastal area of Saba Sarawak in Malaysia is designated as a priority development area according to Saba Development Corridor Blue Print 2008~2025. At Seria coast in Brunei, petroleum and natural gas processing and exporting facilities are developed.

Once a strong earthquake and tsunami occur as pointed out by USGS and other researchers, such areas will possibly be severely affected. It is therefore recommended to implement (a) research on earthquake and tsunami and (b) formulation of disaster management plan in the western coast of the Philippines, central part of Vietnam coast, coastal area of Saba Sarawak, Brunei, and northern coast of Sulawesi Island in Indonesia.



Source: Tsunami simulation by MHD, Malaysia; locations of trenches added by JICA Study Team

Figure 4.2.4 Techtronic Trenches in South China Sea, Sulu Sea and Celebes Sea

24 This issue was raised by the countries facing the seas; and was presented by the Study Team to the representatives from 10 ASEAN countries at the workshop held on 11 June 2011 in Jakarta.

(2) Purpose

a) To conduct research on earthquakes/tsunamis that could possibly occur in South China Sea, Sulu Sea, and Celebes Sea (ASEAN Collaboration),

b) To conduct impact/damage assessment through hazard mapping,

c) To formulate disaster management plans, including monitoring, early warning system and evacuation plan (➔ option only for bi-lateral cooperation),

(3) Target Area for Research/Study

a) The western coast of the Philippines,

b) The coastal area of the central part of Vietnam,

c) Coastal area of Saba Sarawak of Malaysia,

d) Coastal area of Brunei,

e) Northern coast of Sulawesi Island of Indonesia

(4) Research/Study Contents

Activities of collaborative research and study are proposed as follows.

Table 4.2.6 Activities to be Conducted (Draft)

ASEAN Regional Collaboration (ASEAN Collaborative Research)	Development Study for Bi-Lateral Cooperation[Note-1] (Brunei, Indonesia, Malaysia, Philippines, Vietnam)
(1) To conduct collaborative research on earthquake/tsunami in South China Sea, Sulu Sea, and Celebes Sea. (2) To develop earthquake/tsunami models for the target hypo-central region. (3) To conduct computerized tsunami simulations with various assumptions. (4) To propose a scenario of earthquake for each hypo-central region. (5) To propose overall framework of earthquake and tsunami monitoring and warning system.	(1) To review the scenario of earthquake in view of selected target areas. (2) To conduct tsunami simulation based on scenario earthquake with bathymetric information. (3) To estimate damages/losses with reasonably accurate topographic maps, especially for industry-invested area. (4) To evaluate impact on economic activities and supply chain. (5) To propose monitoring system for earthquake and tsunami. (6) To propose tsunami early warning system. (7) To propose disaster management plan. (8) To conduct training on disaster management in related countries.

Source: JICA Study Team

Note-1: Development study in member countries may start after scenario earthquakes are proposed from the collaborative research.

(5) Implementation Framework

A similar framework as in the previous section is proposed in Table 4.2.5.

(6) Implementation Period

- ASEAN Regional Collaboration : 24 months
- Bi-lateral cooperation : 24 months

Table 4.2.7 Implementation Framework (Draft)

ASEAN Regional Collaboration (Input from ASEAN)	Bilateral Cooperation (Input from state where target country)
・ Coordination: AHA Centre ・ Panel of Experts: Disaster related-organizations/institution in ASEAN region: ➢ ASEAN Secretariat[note-1] ➢ Research/academic institutions[Note-2]	・ Counterpart agency: entity in charge of disaster management at the national (NFP), and local levels where the target cities are located and entities in charge of relevant disasters
Input from Japan	
・ Funding Agency: Japan International Cooperation Agency (JICA)[Note-4] ・ Technical Advisors: Research/academic institutions/agency in Japan[Note-3] ・ Implementation: Consultants	
Examples of organization/institutions Note-1 : ASEAN Committee on Disaster Management（ACDM） Committee on Science and Technology (COST) Sub-committee on Meteorology and Geophysics Note-2: ASEAN Earthquake Modeling Group (Nanyang Univ., Singapore）, BMKG(Indonesia), PHIVOLCS(Philippine)) Chulalongkorn University (Thailand), Asia Institute of Technology (Thailand), Southeast Asia Disaster Research Institute (SEADPRI-UKM) (Malaysia) LIPI, Indonesia Univ., ITB, etc. (Indonesia) Note-3: Tokyo University, Kyoto University, Tohoku University, I-Charm (Japan) Note-4: Funding by other sources within ASEAN member countries may be applicable.	

Source: JICA Study Team

4.2.5 Development of ASEAN Disaster Management Information System (ADMIS)[25]

(1) Background

For effective disaster management, a comprehensive database system that stores vast variety of information, which are not only related to disasters but also to socio-economics. Thus, development of GIS based ASEAN Disaster Management Information System (ADMIS) is necessary to support the basic activity of AHA Centre as an information hub for disaster management in the ASEAN region.

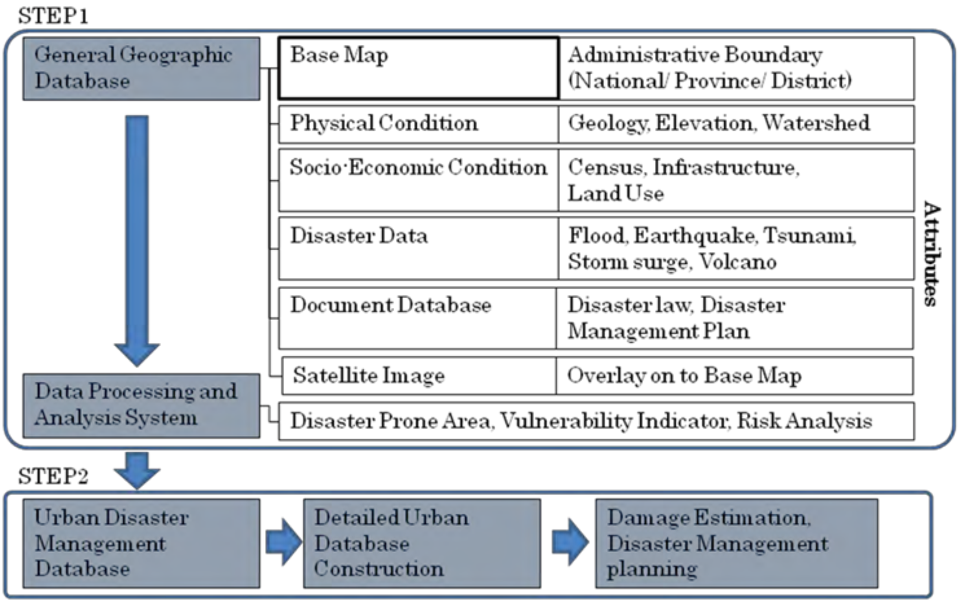
It is understood that the project for the development and deployment of Disaster Monitoring and Response System (DMRS) for the AHA Centre was launched in April 2012. It is expected that the system will offer early warning and decision support systems to be customized for the needs of AHA Centre and the ASEAN member countries. DMRS is considered to become much more powerful if linked with a comprehensive database that ADMIS can provide.

Thus, the present study recommends that the GIS based ADMIS be developed together with data set, which shall be collected as one component of the project.

(2) Concept of ADMIS Development

The concept of the proposed ADMIS is illustrated in the Figure 4.2.5

[25] This issue was briefly presented to the AHA Centre who was interested in the concept.



Source: JICA Study Team

Figure 4.2.5 Concept of ADMIS

ADMIS shall be developed in the following two steps.

1) The First Step of ADMIS Development

The first step consists of development of a general database, data collection and development of data analysis system

a) Development of a general database and data collection

In this step, general map data with scale of one to one million covering each ASEAN member country is created. Together with the creation of a base map, related natural and physical data, socio-economic data, infrastructure data, census data, and disaster data will be collected. Existing digital files of these geographic and statistical data will be utilized as much as possible to avoid duplicated investment.

Data collection items are indicated below as examples:

Table 4.2.8 Example of Information to be Collected

a.	Administrative boundary such as national, provincial, district, etc.,
b.	Census data such as population,
c.	Socio-economic statistics including income level,
d.	Existing land use,
e.	Physical conditions such as elevation, geology, fault line, and watershed boundary,
f.	Climatic data,
g.	Main road network, railway network, port location, airport location, urban center,
h.	River network, lakes, reservoirs, dam,
i.	Main hospitals related to disaster management,
j.	Satellite imageries, and
k.	Others.

Source: JICA Study Team

Collected map data will be specifically manipulated to adjust its scale and legends, and finally integrated into a uniform projection system.

b) Development of data analysis system

Data processing and analysis system are among the important aspects, which will be developed for effective use of geographic database using the overlay technique, for example, the spatial analysis.

In addition to the development of data processing and analysis system, many numerical data will be analyzed and mapped to generate indicators to support decision making. General vulnerability indicators for example will be generated through the numerical data analysis, and mapped using the data processing and analysis system. These will result in general vulnerability maps. Thereafter, existing disaster prone areas will be combined with the general vulnerability maps to identify fundamentally problematic areas in the ASEAN region.

ADMIS will be linked with related database system or existing regional disaster management system such as flood risk analysis and earthquake disaster analysis.

2) The Second Step of ADMIS Development

The second step of ADMIS development will focus on detailed geographic database development for large or megacity disaster management system. Large topographic maps with scales such as 1:2,500 or 1:5,000 will be collected /generated in this system for the creation of a detailed database system. Similar information is listed in Table 4.2.8 although more detailed information shall be collected.

AHA Centre will conduct the necessary systems operation and maintenance through effective use of GIS-based ADMIS for disaster management.

(3) Issues to be solved for ADMIS Development

In order to develop ADMIS, the member countries shall agree on map data sharing system including the scale, projection system and accuracy, data collection and dissemination methodology in disaster management field.

Specific cooperation with AHA Centre will be needed to make a general agreement for ADMIS development, similar to the cooperation being conducted for the development of ASEAN Guideline on flood risk assessment.

(4) Implementation Framework

The study proposes the following framework for implementation. The AHA Centre is expected to act as the coordinator for the project.

Table 4.2.9 Activities to be conducted

ASEAN Regional Collaboration	In Each Member State
• Creation of ADMIS	• Collection of information for the database system. The information to be collected will also be provided to each member state for the creation of their own database system, which may be implemented in the next stage.

Source: JICA Study Team

Table 4.2.10 Implementation Framework

ASEAN Regional Collaboration	In Each Member State
• Counterpart/coordination: AHA Centre • Implementation: Consultants • Cooperation: PDC*1	• Collaboration: the ASEAN member countries
• Funding agency: Japan International Cooperation Agency (JICA) Note *1: Pacific disaster center implemented DMRS project	

Source: JICA Study Team

(5) Implementation Period

1. Preparation : 6 months
2. Data collection in the ASEAN member countries : 6 months
3. Development of database, creation of analysis system : 9 months

Total : 21 months

4.2.6 Disaster Information System in Major Cities of ASEAN Region with ASEAN Common Data Format[26]

(1) Background

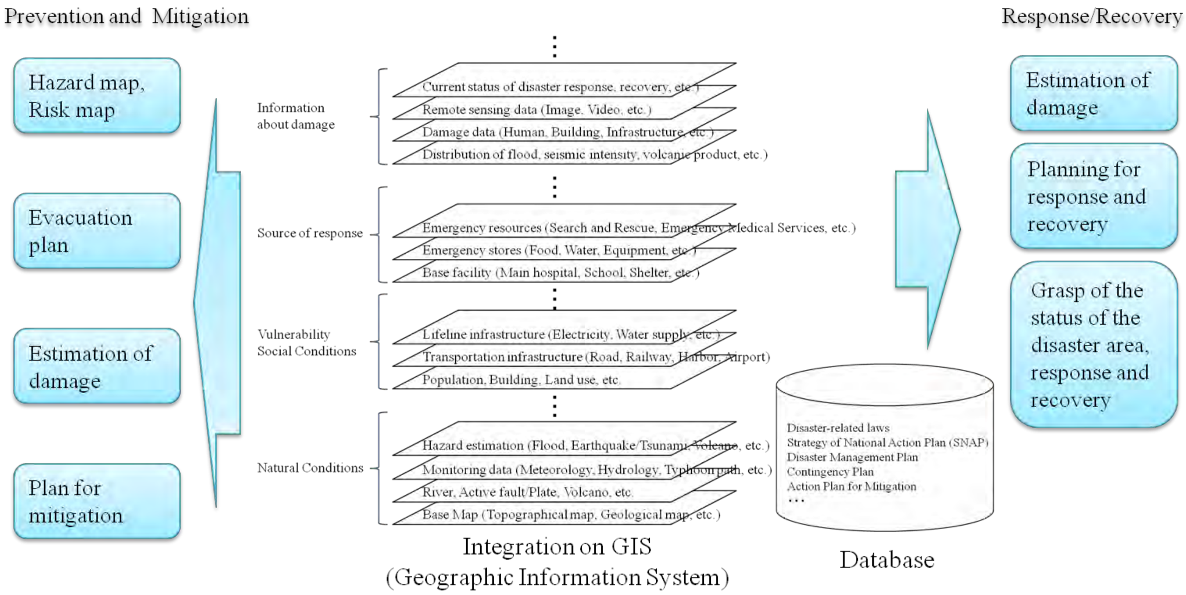
In order to materialize the disaster risk reduction, conducting disaster risk assessment should be a prerequisite condition. This will require various sets of information regarding past disaster records, socio-economic conditions, natural, and physical constitutions, and so on. Therefore, DMIS should be introduced to integrate such valuable information. The DMIS will also be utilized for formulation of disaster management plan, as a decision making tool when disasters occur as well as data accumulation of disaster related information. Though little autonomy of ASEAN countries has introduced such DMIS at present, it is expected for them to introduce soon the DMIS for disaster risk management.

The AHA Centre, as the coordinating body of ASEAN disaster management, should be linked to the DMIS of ASEAN member countries for smooth coordination with shared information. For this purpose, data type, accuracy, format, and so on of essential information will have to be standardized among the ASEAN member countries.

This proposed program will provide standard format of data, which will be stored as part of the database in DMIS of the ASEAN member countries. It will also build the DMIS for

[26] This issue is proposed by the JICA Study Team in this report.

targeted local autonomies such as megacities with information to be collected in the program, in accordance with the specifications to be proposed by this program.



Source: JICA Study Team

Figure 4.2.6 Conceptual Image of DMIS

(2) Alignment with the ASEAN's Effort in Disaster Management

The "Risk Assessment, Early Warning and Monitoring" is one of the four strategic components of the AADMER Work Program 2010-2015, proposing "GIS-based Disaster Information-Sharing Platform for Early Warning" as one of its flagship projects. Accordingly, the Daft AHA Centre Strategic Work Plan includes "monitoring for disaster alert and assessing potential disaster situation" as Function 2; and "ASEAN Strategy on Disaster Risk Assessment (the draft roadmap for risk assessment)" selected "ASEAN-wide Disaster Risk Assessment" as the subject in the executive summary.

As such, this program proposed aligned with the ASEAN efforts in disaster management

(3) Activities Proposed

- Propose ASEAN common data format for DMIS.
- Build disaster management systems for targeted cities that need special attention to multi-hazard disasters. The systems will also be equipped with data analysis system.
- Collect information necessary and store them to the disaster management systems built by this program. Consequently, the system will be a proto-type of disaster management systems to be introduced to other cities of the ASEAN member countries.

(4) Implementation Framework

- Targeted institutions/organizations:

Table 4.2.11 Targeted Institutions/ Organizations

Outputs	Target institutions/organization
Proposing ASEAN common data format of disaster management systems	ASEAN member countries through AHA Centre
Building DMIS with necessary data collection	Mega cities to be proposed

Source: JICA Study Team

- Coordination: AHA Centre
- Implementation: Consultants
- Funding Agency: JICA

(5) Period Required

- Formulation ASEAN Common data format : 6 months
- Data collection in targeted cities : 6 months
- Database design, data input and data analysis system : 9 months

4.2.7 Others Subjects for Collaborative Research

1) Research community based disaster, management with consideration of national/local cultures of ASEAN regions
2) Case studies of community disaster management exercised in the Great East Japan Earthquake and their applicability to the ASEAN region.
3) Research on psychology and reactions in cases of huge disaster, and its applicability to disaster management.
4) Research on effectiveness of mangrove forest against tsunami – case studies.
5) Research on effective promotion of evacuation exercise in ASEAN Countries
6) Research on disaster-proof infrastructure with optimized cost and benefits.
7) Research on comprehensive disaster risk assessment of megacities in ASEAN countries.
8) Research on worst case scenario simulation for disaster management in ASEAN region, leaning from the Great East Japan Earthquake.

CHAPTER 5 ORGANIZATION AND INSTITUTION

5.1 Brunei

5.1.1 Disaster Management Law and Policy

The legal basis and guideline of disaster management in Brunei Darussalam is the Disaster Management Order (DMO) of 2006, which prescribes the responsibilities and authority of the National Disaster Council (NDC) and National Disaster Management Center (NDMC). A disaster management component is included in each sector by sector law. It is therefore considered that developing a comprehensive disaster management law is unnecessary.

The Outlines of Strategy and Policy for Development (OSPD), 2007-2017 manifests policy directions for "developing further appropriate systems and organizations, for responding quickly and effectively to threats from natural disasters, infectious diseases, acts of terrorism, and other emergencies"[1].

5.1.2 Disaster Management Plan and Budget

Article 18 in the DMO requires NDC to prepare a national disaster management plan. The NDMC explains that the plan is composed of the national "standard operating procedures (SOP)"[2] and the Strategic National Action Plan for Disaster Risk Reduction 2012-2025.

An annual budget of BND 5 million has been allocated each to the Ministry of Home Affairs, Ministry of Health, and Ministry of Finance. This budget is for disaster management activities, which includes disaster preparedness and disaster risks reduction, and can be used by all government agencies.

5.1.3 Disaster Management Organization

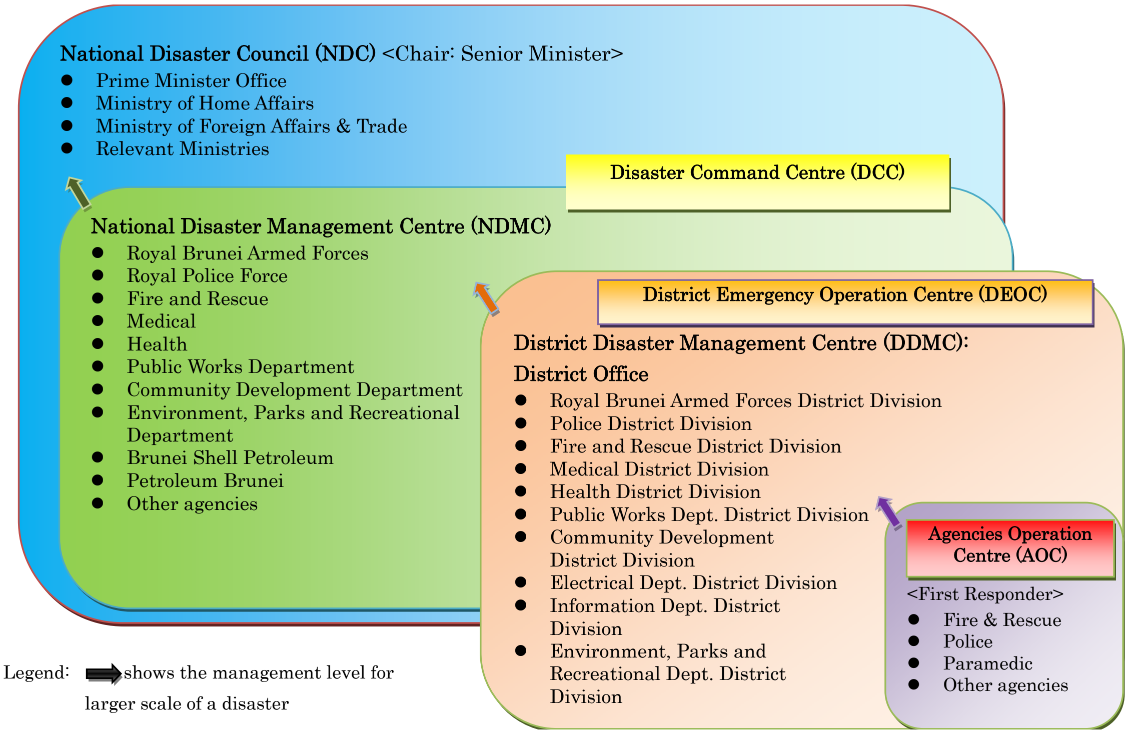
The NDC is the highest authority to strategize for disaster management in Brunei. The council is co-chaired by the Senior Minister and Minister of Home Affairs. Besides, two other ministers are also appointed as co-chairs according to the nature of disasters. NDC's secretariat is the Chief Director of the Ministry of Home Affairs.

Under NDC, the NDMC is established as the implementation agency[3]. NDMC has put up the Disaster Command Center in place. In a disaster, an Incident Command Post (ICP) is established.

Brunei's local administration is composed of four districts. In all districts, a District Disaster Management Center and District Emergency Operation Center are established.

The organizational structure of Brunei's disaster management is shown in Figure 5.1.1 below.

[1] Brunei Darussalam (2012) Strategic National Action Plan for Disaster Reduction for Disaster Risk Reduction 2012-2025, p.11.
[2] The final approval is waited (as of April 2012).
[3] It consists of 25 permanent staffs and 25 others including secondments from the Fire Service. NDMC is still in the course of reform for further integration of disaster-related agencies.



Source: NDMC <Edited by JICA Study Team>

Figure 5.1.1 Brunei's Disaster Management Structure

5.1.4 Disaster Management at Community Level

Each district prepares a "response plan" following the NDMC guideline (SOP), which is provided as a community-based disaster risk management program. Hazard map is prepared by every community as one of the program components.

5.1.5 Issues and Needs concerning Organization and Institution

(1) Issues[4]

a) To integrate disaster-related agencies into the current provisional NDMC structures;

b) To enhance NDMC's expertise, especially for tsunami disaster); and

c) To arrange hazard maps for all communities.

(2) Needs[5]

a) Further institutionalization of NDMC with a scope of public sector reform;

b) Training for disaster management specialist to improve their expertise; and

c) Preparation of community hazard maps in right scale and quality.

[4] All the items are identified by NDMC in the interview with the JICA Study Team.
[5] All the items are attributed to the JICA Study Team.

5.2 Cambodia

5.2.1 Disaster Management Law and Policy

The Law on Disaster Management is in the progress of arranging for a full session cabinet meeting and then submit to the legislative bodies to be enacted accordingly.

The National Committee for Disaster Management (NCDM) issued its policy document for disaster management in 1997; nevertheless, no actions have been taken except for responsive activities. A national contingency plan to tackle flooding and drought has been formulated since 2011, which requires a decree of the improvement and update by sector respectively.

5.2.2 Disaster Management Plan and Budget

Although the Strategic National Action Plan for Disaster Risk Reduction (2008-2013) was officially launched in 2009, and it has gradually implemented by the relevant stakeholders through cross sectors in Cambodia.

The state has appropriate budget reservation to ensure the disaster management. Every year, NCDM has to formulate a budget plan for implementation of disaster management by incorporating into annual budget plan of the Office of the Council of Ministers in order to allocate and utilize.

Budget for the disaster management is under law on finance and the sources come from the state budget, national and international development partners' budget and charitable persons' budget.

5.2.3 Disaster Management Organization

NCDM has been established in 1995 as a core institution and assistance to the Royal Government of Cambodia to lead, manage, and coordinate the disaster management tasks.

The Prime Minister is the President of NCDM. The Prime Minister could appoint a member of the Royal Government as the first vice president to be in charged on behalf.

The secretariat general of NCDM is the assistance for the day to day operations. This secretariat general shall be governed by a secretary-general and a number of deputy secretary generals as deemed necessity. The NCDM secretariat-general consists of 47 government official status.

The secretariat-general of NCDM shall consist of an "Emergency Coordination Center" under its management structure.

The government ministries-institutions shall establish a disaster management mechanism in their respective ministries-institutions and appoint a focal point for permanently coordination and communication with the secretariat general of NCDM.

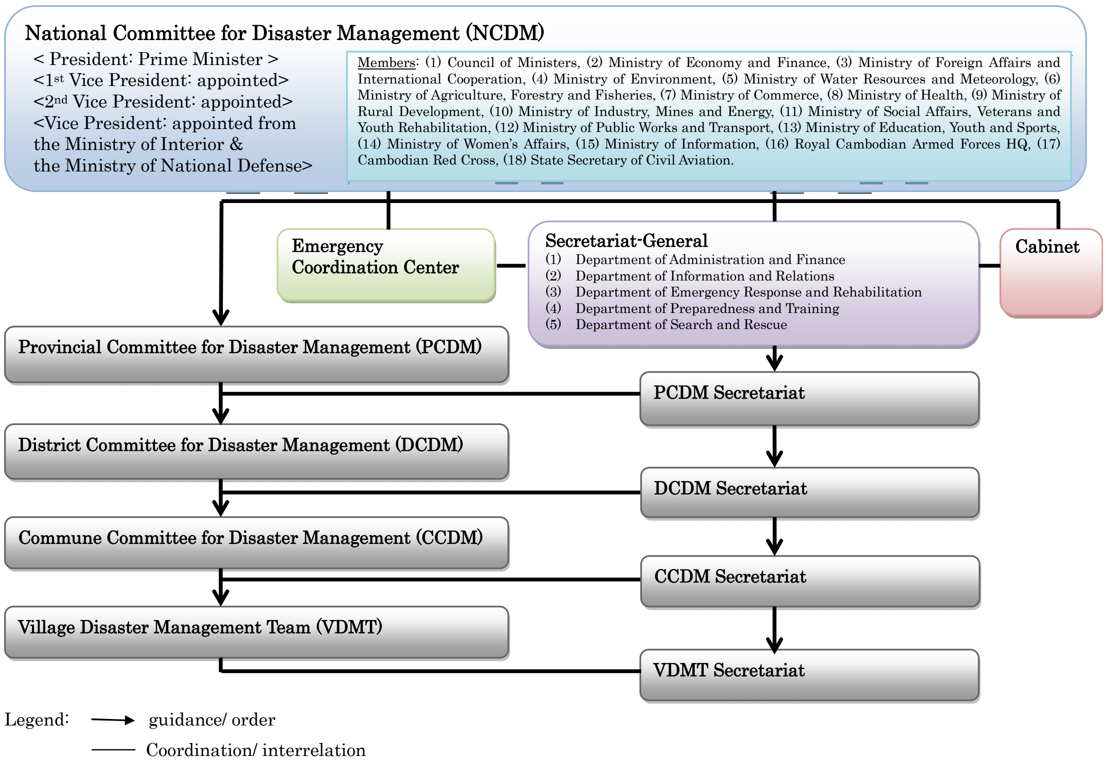
NCDM shall consist of the sub-national committee for disaster management that composted of city-provincial committee for disaster management, town-district committee for disaster management and commune-committee for disaster management.

In its competent territory, the governor of province/city, the chief of district/town and the chief of commune shall be the president of the committee for disaster management, and the deputy governor of province/city, the deputy chief of district/town and the deputy chief of commune shall be the vice president of the committee for disaster management.

The province/city, district/town, and committee for disaster management shall consist of the secretariat for its respective task operations.

The organization and function of the sub-national committee for disaster management shall be determined by a Sub-Decree.

The organizational structure of Cambodia's disaster management is shown in Figure 5.2.1 below.



Source: A presentation material provided by NCDM [September 2012] and "NCDM-DMIS Aide Memoire", a document provided by NCDM [September 2012].

Figure 5.2.1 Cambodia's Disaster Management Structure

5.2.4 Disaster Management at Community Level

As indicated 5.2.3 above, even the commune level has disaster management committee structure[6]. As instructed by NCDM, the commune-sangkat chiefs is supposed to issue an order

[6] "NCDM-DMIS Aide Memoire", a document provided by NCDM [September 2012].

to establish the Village Disaster Management Team (VDMT) comprising 7 people in order to strengthen the community-based disaster risk management[7].

Many projects are implemented to empower communities and authorities with limited resources and less granted delegation. Local authorities provide facilitation roles but do not primarily implement projects, which results in less sustainability accompanying capacity development and ownership[8].

NCDM has committed to promote the participation of communities in disaster risk reduction by strengthening and simplifying the early warning system for local communities[9].

5.2.5 Issues and Needs Concerning Organization and Institution

(1) Issues[10]

a) To create Law on management law and to prepare the next Strategic National Action Plan after 2013;
b) To prepare the local level action plan on the basis of (new) Strategic Action Plan as the guideline;
c) To provide NCDM with a clear mandate and the authority to make resource mobilization possible;
d) To allocate resources to local level disaster organizations once local action plans are prepared;
e) To set up local disaster management organizations; and
f) To plan and implement community-based disaster management by PCDM or other levels.
g) To coordinate between national level and sub-national level to have the consistent figures of loss and damage in each sector to provide certain information in making reconstruction plans

(2) Needs[11]

a) Preparation of the next term Strategic Action Plan and subsequent local action plans formulated by the provincial and subordinate levels;
b) Establishment of secretariat offices at all provincial levels; and
c) Capacity development of PCDM, with continuous support of international organizations and NGOs, and other sun-national levels as well as communities to plan and implement community-based disaster management.
d) Establishment of the mechanism/system of coordinated information on damage and loss among national level and sub-national level in each sector.

[7] NACM Direction No. 315, "Implementation of Direction on the Community-Based Disaster Risk Management (CBDRM) for Emergency Preparedness and Hazard Control", [Un-Official English Translation].
[8] Cambodia (2009) *National Progress Report on the Implementation of the Hyogo Framework for Action (2007-2009)*, pp.5-6.
[9] A presentation material provided by NCDM [September 2012] .
[10] The issues in a) b) and d) are identified by NCDM in the interview with the JICA Study Team, while those in c), e) and f) are attributed to the JICA Study Team.
[11] The view in b) is identified by NCDM in the interview with the JICA Study Team, while the views in a) and c) are attributed to the JICA Study Team.

5.3 Indonesia

5.3.1 Disaster Management Law and Policy

The Disaster Management Law (No. 24) was enacted in 2007. Ancillary regulations for this law are also enacted in 2008: 1) Regulation No. 22 on Disaster Aid Financing and Management, 2) Regulation No.23 on Participation of International Institutions and Foreign Non-Governmental Organizations in Disaster Management, and 3) Regulation No.8 on National Agency Disaster Management. Disaster mitigation aspects are reflected in nearly all of the ministries' policy framework.

5.3.2 Disaster Management Plan and Budget

In 2006, the National Action Plan for Disaster Reduction 2006-2009 was issued. The budget for disaster management had been allocated to special recovery fund for the incurred disasters, to Public Works, the Department of Social Services, and the disaster management agency, BAKORNAS PB (National Coordinating Board for Disaster Management). This was done without giving BAKORNAS PB an authority over budget control for disaster management activities.

Following its former plan and as Law No. 24 requires, the National Action Plan for Disaster Risk Reduction 2010-2012 was issued by BAPPENAS (the State Ministry for National Development Planning) and BNPB (National Agency for Disaster Management) in 2010 as the basis and reference for the stakeholders to implement disaster management measures. ‘ By March 2012, all 33 provinces have prepared provisional versions of their respective plans[12]. The local plan is supposed to be prepared in the regency and city level where BPBDs (Local Disaster Management Agency) are also to be established. Disaster Management is one of the priorities in the National Middle-term Development Plan (2010-2014) .

The National Disaster Management Plan 2010-2014 was also issued by BNPB (National Agency for Disaster Management) for reference in order that disaster management activities/programs are integrated into the mainstream strategic plans for every government organization in Indonesia. The National Disaster Management Plan consists of data and information related to disaster risks in Indonesia in 2010-1014 and of the government's plan to reduce these risks through development programs and activities.

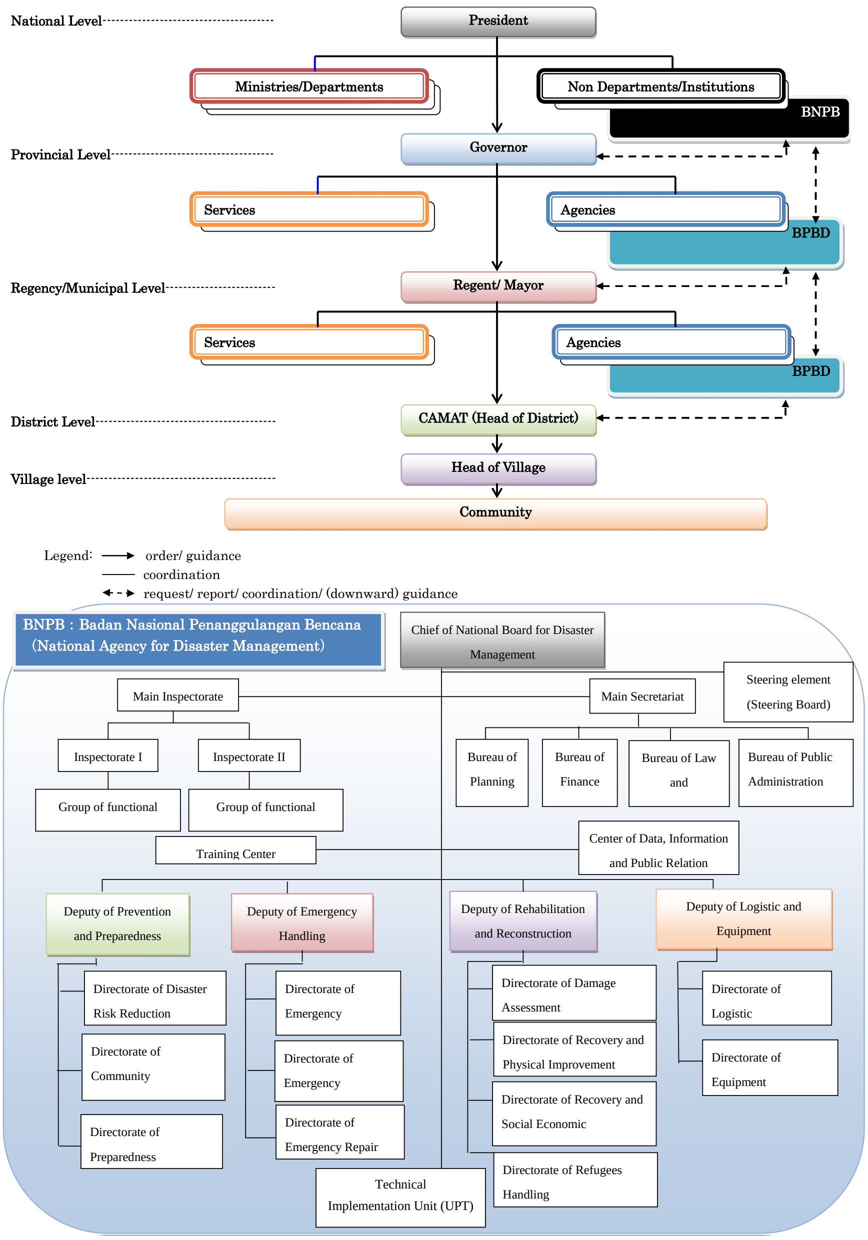
The new law ensures that BNPB has authority of budget control to a certain degree (including "ready fund"). Within the scope of decentralization, regional government budgets such as the special allocation fund and de-concentration fund are available to strengthen institutions, emergency response, and recovery/rehabilitation expense.

5.3.3 Disaster Management Organization

In 2008, BNPB was established as a comprehensive disaster management implementation and coordination body. BNPB is a non-departmental agency similar to the ministries with about

250 staffs[13]. The Chief of BNPB, with equal rank to the ministers, has an obligation to report to President of Indonesia once a month. BNPB is a self-contained agency comprising the elements as the ‘steering committee’ and ‘management executing body’.

It is supposed that BPBD (Local Disaster Management Agency) is established at every province, district, and city. All 33 provinces already have BPBDs, while 395 out of 405 regencies and 97 cities have established them[14].



Sources: (Above) Dr. Syamsul Maarif, Msi (date unknown) *Disaster Management in Indonesia*, (Presentation Slide), p.11. (Below) http://www.bnpb.go.id/website/asp/content.asp?id=4 [Accessed: June 3, 2012] (BNPB’s organogram was provisionally translated in English by the JICA Study Team)

Figure 5.3.2 Indonesia’s Disaster Management Structure (Top) and BNPB’s Organogram (Bottom)

[12] According to interview survey to BNPB by JICA Study Team (2012)
[13] According to the information obtained from BNPB by JICA Study Team (2012)
[14] Indonesia (2011) *National Progress Report on the Implementation of the Hyogo Framework for Action (2009-2011)*, p.3.

5.3.4 Disaster Management at Community Level

Clauses 26 and 27 of the Disaster Management Law No.24 prescribe the rights and obligations of the community in disaster management. Several activities have been conducted by government agencies and donors. BNPB has conducted the Resilient Village Program for selected villages. Nevertheless, it is said that the communities have not been well-involved in the formulation process of disaster management and risk reduction programs. The existing mechanism needs to be improved in terms of the participatory process, which applies to the same issue of information dissemination to, and valid data collection from, the community[15].

In the case of DKI Jakarta, BPBD has created closer relationship with local communities, networking and having meetings with them from time to time, and listing available resources with which these communities can provide when disaster strikes.

5.3.5 Issues and Needs Concerning Organization and Institution

(1) Issues[16]

a) To enhance understanding and prioritize disaster risk reduction at the local level;
b) To apply BNPB's guideline for the preparation of a Regional Action Plan for Disaster Risk Reduction at the BPBD level;
c) To enhance expertise in both BNPB and BPBDs; and
d) To get valid data and information of community-based disaster management in place in order to prepare local level risk maps.

(2) Needs[17]

a) Dissemination and mainstreaming of disaster risk reduction at the local level;
b) Training of BNPBs' as well as BPBDs' experts/staffs for capacity development; and
c) Development of BPBD's capacity to implement community-based disaster management activities.

5.4 Lao PDR

5.4.1 Disaster Management Law and Policy

It is expected that the Prime Minister's Decree to order the preparation of a Disaster Management Law will be issued by around October 2012. If the decree is issued as assumed, the law will be started to be prepared targeting to be enacted within 2013. The policy basis of Lao PDR's disaster management is the strategic plan to be discussed in Section 5.4.2 below.

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15 *Ibid.*, p.7.
16 All the views, based on the analysis of Indonesia's "*National Progress Report on the Implementation of the Hyogo Framework for Action (2009-2011)*" and the answer sheet of the questionnaire prepared for the study, are attributed to the JICA Study Team.
17 All the views are attributed to the JICA Study Team.

5.4.2 Disaster Management Plan and Budget

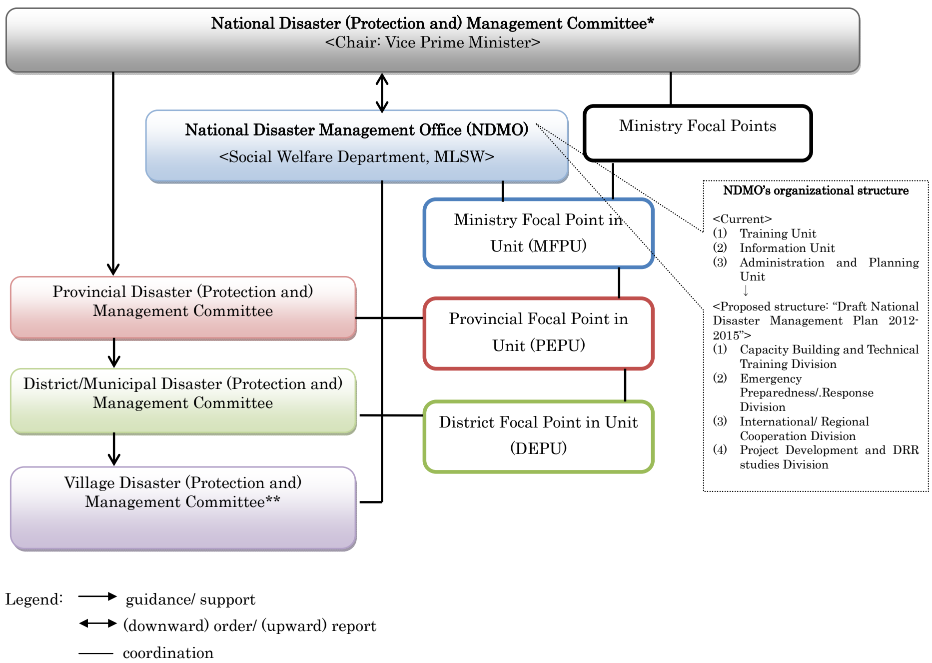
A four-page paper entitled the “Strategic Plan on Disaster Risk Management in Lao PDR 2020, 2010 and Action Plan (2003-2005)” was issued in the form of Decree No.158 by the Ministry of Labour and Social Welfare (MLSW) in 2003. The plan lists long-term aims up to 2020 and goals for the medium-term until 2005 and 2010.

The new plan called the National Disaster Management Plan 2012-2015 has been drafted and reviewed. A decree from the Prime Minister is necessary for the above new plan to be implemented even after it is finalized. The MLSW, where the National Disaster Management Office (NDMO) belongs to, was allocated a fund totalling around LAK 1 billion for immediate use for disaster response in 2011, while government-wide annual allocation of emergency fund from the national budget amounts to around LAK 160 billion for 2009-2010 and LAK 100 billion for 2010-2011.

Five out of 17 provinces[18] and some of their districts have prepared provincial/district disaster management plans. The budget allocation at the local level seems insufficient.

5.4.3 Disaster Management Organization

Prime Minister Decree No. 158 was issued in 1999 in order to establish the National Disaster Management Committee (NDMC) and to position the NDMO within MLSW.



Source: Draft National Disaster Management Plan 2012- 2015, p.26. <Partly added by JICA Study Team>

Note: *NDMC is renamed by the draft decree on National Disaster Protection and Management (Provisional English Translation by the JICA Study Team). Differences are bracketed off. ** Committee at the village level is established especially where there is high risk. It is currently called the Village Disaster Protection Unit (VDPU) in the draft National Disaster Management Plan 2012- 2015.

Figure 5.4.1 Lao PDR’s Disaster Management Structure

[18] Five provinces are: 1) Khammouane, 2) Savannakhet, 3) Vientiane, 4) Sayaboury, and 5) Saravan.

NDMC, which consists of the ministries, is chaired by the Deputy Prime Minister. Committees are also established in all the provinces (PDMC) and districts (DDMC). The Village Disaster Protection Unit (VDPU) is also set up at the village level.

NDMO has been established with the function of policy formulation for disaster management since 1997. It is located within the MLSW playing the secretariat function for NDMC. NDMO has units for training, information, and administration/planning with nine staff members. The NLSW departments at the local administrative level also play the secretariat roles for the respective disaster management committees.

Disaster management, including the NDMC structure and function, is under review and a new decree to adjust the current situation has been drafted.

5.4.4 Disaster Management at Community Level

Community-based disaster management programs are implemented by various donors targeting not only village people but local governments.

NDMO organizes public awareness events and activities every second week of October, commemorating the ASEAN International Disaster Management Day.

5.4.5 Issues and Needs Concerning Organization and Institution

(1) Issues[19]

a) To establish the legal basis on disaster management;
b) To enhance capacity of local governments to be able to prepare disaster management plans;
c) To build a function for disaster prevention and mitigation within NDMC or to provide NDMO with authority to play the main role in terms of inter-ministerial coordination;
d) To adjust the division of labor between NDMO and the newly established Department of Natural Disaster Management and Climate Change in the Ministry of Natural Resources and Environment, which is also mandated to deal with (water-related) disaster management; and
e) To allocate the budget to benefit all the communities impartially in order to standardize their capacity.

(2) Needs[20]

a) Preparation of a disaster management law, including appropriate institutional and organizational settings as well as standardized frameworks of the disaster management plan;
b) Preparation and standardization of local level disaster management plans; and

[19] The view in a) is identified by NDMO in the interview with the JICA Study Team, while the views from b) to e) are attributed to the JICA Study Team.
[20] The view in a) is identified by NDMO in the interview with the JICA Study Team, while the views in b) and c) are attributed to the JICA Study Team.

c) Institutionalization of community-based disaster management at the local level through provision of training for both local government officers in charge and communities' members.

5.5 Malaysia

5.5.1 Disaster Management Law and Policy

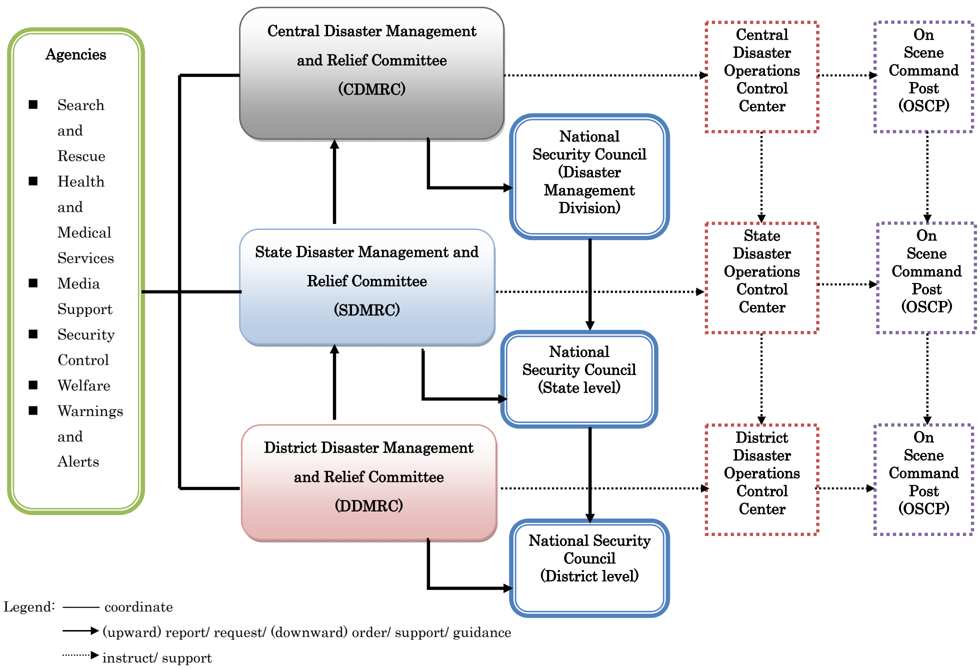
Malaysia has no specific disaster management law. However, it has a disaster management policy and mechanism known as the National Security Council (NSC) Directive No. 20 approved by the Prime Minister in 1997. NSC Directive No.20 is in the course of revision to shift its paradigm from emergency response to disaster prevention and mitigation as agreed among ASEAN countries. This revised NSC No.20 is to be approved by the Prime Minister in March or April 2012. NSC is considering to prepare a disaster management law once the new NSC No.20 is approved.

5.5.2 Disaster Management Plan and Budget

There is no specific disaster management plan but preparation of one is intended once the new NSC No.20 is approved. Due to the absence of a disaster management law, NSC has not enough allocation of budget in an integrated manner for disaster prevention and mitigation activities. A budget for mitigation measures for flood and its monitoring activities is allocated to the implementing agency, i.e., the Department of Irrigation and Drainage.

Local disaster management plans have not been considered necessary.

5.5.3 Disaster Management Organization



Source: A. Fakhru'l-Razi (date unknown) *Disaster Management in Malaysia* (PPT Slide), p.36.

Figure 5.5.1 Malaysia's Disaster Management Structure

The Central Disaster Management and Relief Committee (CDMRC) were established at the federal state level, which is chaired by the Minister[21] and appointed by the Prime Minister. Also established are the state (SDMRC) and district (DDMRC) committees at their respective levels. It depends on the scale of the affected area what level of committee is responsible for principal response. Monsoon-related flood is seasonal and tends to have nationwide effect, which is mainly handled by CDMRC.

The NSC is the implementing agency for disaster management. NSC Directive No.20 mandates NSC to establish a Disaster Management Division (DMD). The DMD at the headquarters has 17 staff members as of March 2012[22]. The NSC local departments play the secretariat roles for respective state and district levels of the committee.

5.5.4 Disaster Management at Community Level

Malaysia has disseminated disaster information to communities and implemented community-based disaster management programs, which helps in improving people's awareness of disaster management. Disaster drills are also conducted regularly. In 2011, a "Disaster Awareness Day" campaign was organized with selected role-model cities, which is aimed in particular to encourage other cities to be active in disaster awareness in respective local context.

5.5.5 Issues and Needs Concerning Organization and Institution

(1) Issues[23]

a) To have a disaster management law as well as national disaster management plan;
b) To improve the organizational structure, adjusting the shift of disaster management orientation from emergency response to prevention and mitigation; and
c) To mobilize resources to develop capacity and tools for most disaster-prone areas, encouraging community participation.

(2) Needs

a) Preparation of disaster management law and national plan;
b) Mainstreaming disaster management into local plans;
c) Integration of prevention and mitigation aspects into institutional and organizational setups; and
d) Promotion of community-based disaster management activities and planning in most disaster-prone areas.

[21] It is the Deputy Prime Minister as of March 2012.
[22] About 360 personnel in total (all federal, state and district administrative levels)
[23] The views in a) and c) are identified by NSC in the interview with the JICA Study Team, while the view in b) is attributed to the JICA Study Team.

5.6 Myanmar

5.6.1 Disaster Management Law and Policy

The Disaster Management Bill has been drafted and submitted to the Union Attorney-General for scrutiny. It would then be submitted to the Parliament for approval. It is expected to be approved by around June 2012. A new Constitution issued in 2008 has changed Myanmar's political system into presidential one, which affects disaster management structure. The Disaster Management Law is expected to define the role and structure of the organization and agencies engaged in disaster management clearly. Disaster management policies and guidelines have been prepared by the Central Committee on National Disaster Prevention (currently renamed as the Myanmar Disaster Preparedness Agency, MDPA) established in 2005.

5.6.2 Disaster Management Plan and Budget

The Myanmar Action Plan on Disaster Risk Reduction (MAPDRR) 2009-2015 has been prepared but it requires endorsement of the national government to be a formal document. Nevertheless, some of the project components indicated in MAPDRR have been implemented on stand-alone basis, most likely with donor support. Especially, the change of political system, needs to be reflected in the MAPDRR in its revised version to be prepared. Same revision needs to be applied to the "standing order" originally prepared in 2009.

Due to the absence of a policy directive for fund allocation of disaster management, the financial resources are believed insufficient. Nevertheless, there are some resources, such as: 1) the Ministry of Finance's special fund for rehabilitation works, and 2) the Ministry of Social Welfare, Relief and Resettlement (MSWRR)'s budget for relief activities and capacity-building on disaster risk reduction[24]. Also, the disaster-related budget is not clearly separated at the ministerial as well as the local government (state/ region) level.

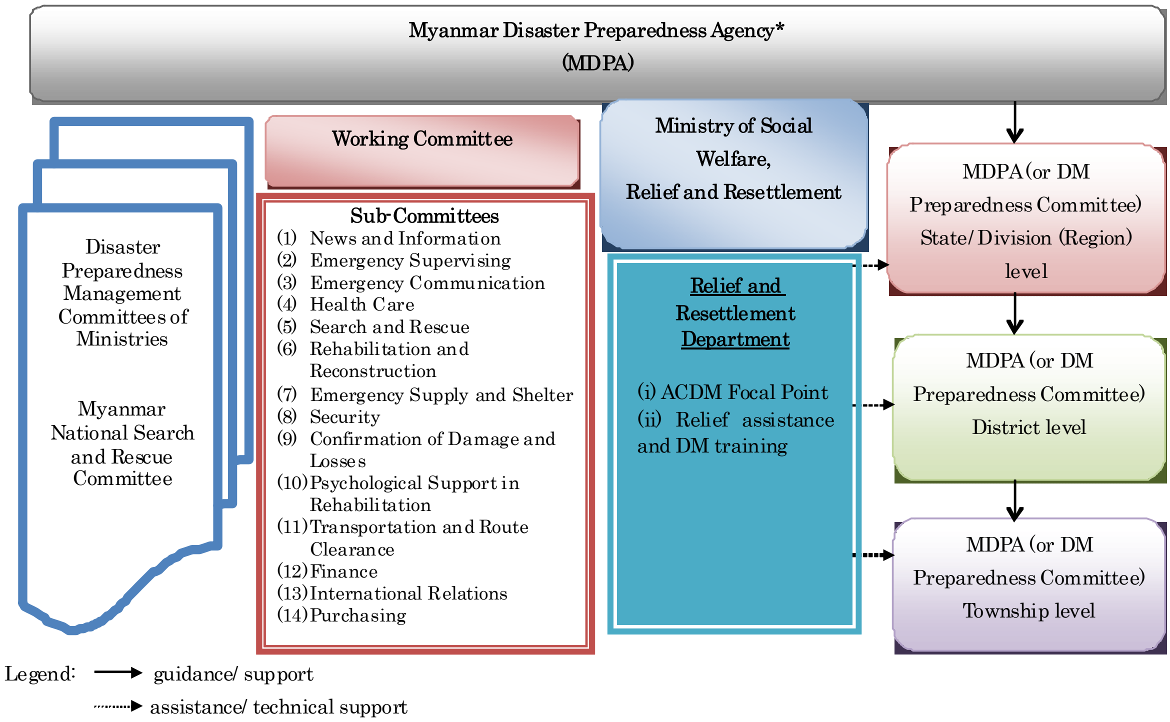
Apart from regional/ state flood protection plans, comprehensive disaster management plans and/or action plans does not seem to have been prepared at the local level.

5.6.3 Disaster Management Organization

The original institutional framework in MAPDRR describes that the "National Disaster Preparedness Central Committee" for disaster preparedness, chaired by the Prime Minister. Currently, the Minister of Social Welfare, Relief and Resettlement Department chairs the new organization, MDPA, under the new institutional framework. The Minister of Defence and the Minister of Home Affairs are co-vice-chairmen for MDPA. The Deputy Minister of MSWRR is the secretary, and RRD's Director General is the joint secretary for MDPA. The working committee to supervise the implementation of disaster management activities and several sub-committees for effective implementation of activities are also instituted[25]. Ministerial level of the committees is also organized.

[24] Myanmar (2010) *National Progress Report on the Implementation of the Hyogo Framework for Action (2009-2011)- interim*, pp.5-6.
[25] It can also be a subject for revision as new institutional structure is introduced.

The local level disaster management structure has not changed much, but its chairman is assumed by the Chief Minister at the state/regional level following the new administrative structure under the new Constitution. Similar structure and chairmanship are applied to districts, township and towns/wards/village-tract levels, respectively.



Source: JICA Study Team

Note: *New name "MDPA" is used here as it is mentioned among related government officers in Myanmar. As it is still under reform, names of organizations at the local level are indicated in both possible new names and current names.

Figure 5.6.1 Myanmar's Disaster Management Structure

5.6.4 Disaster Management at Community Level

International organizations, Red Cross and NGOs have provided grassroots level assistance to the communities affected by Cyclone Nargis in 2008, which has made them to institutionalize disaster preparedness setup. However, other areas of the country have not developed the same setup as external support is partially provided to those affected areas of the cyclone.

MAPDRR includes community-based disaster preparedness and risk reduction programs as the plan.

5.6.5 Issues and Needs Concerning Organization and Institution

(1) Issues[26]

a) To institutionalize disaster management (with policy shift from emergency response orientation to prevention and mitigation) along the lines with the new law being approved);
b) To update MAPDRR and consolidate budget items for disaster risk reduction;
c) To implement MAPDRR projects in coordinated and integrated manner;
d) To enhance expertise in MDPA; and
e) To internalize and outspread community-based disaster management.

(2) Needs

a) Institutionalization of disaster management structure on the basis of new law;
b) Preparation of disaster management plan at the local level including development of planning capacity of local committee;
c) Provision of capacity building programs by way of training of trainers for MDPA staffs to obtain expertise in disaster management subject; and
d) Provision of capacity building programs for local MDPAs (or Disaster management and preparedness committees) to be able to manage community-based disaster management.

5.7 Philippines

5.7.1 Disaster Management Law and Policy

The Disaster Risk Reduction and Management Act (Republic Act 101211) were issued in 2010 aiming at strengthening disaster management system with the management framework. The act also institutionalizes the management plan and appropriation fund. The act contains the paradigm shift from emergency response to disaster prevention and mitigation.

Republic Act 101211 complements with the Climate Change Act (Republic Act 9729) in terms of implementing rules and regulations.

The Philippines has formulated the roadmap known as the Strategic National Action Plan 2009-2019 to sustain disaster risk reduction initiatives stated some decades ago in Presidential Decree 1566. The action plan enforces institutionalization of disaster risk reduction to be integrated into government policy.

5.7.2 Disaster Management Plan and Budget

In February 2012, the National Disaster Risk Reduction and Management Plan (NDRRMP) 2011-2028 were approved. NDRRMP covers four thematic areas, namely, i) disaster prevention and mitigation, ii) disaster preparedness, iii) disaster response, and iv) disaster

[26] The view in b) is identified by MDPA in the interview with the JICA Study Team and is also mentioned in Myanmar's "*National Progress Report on the Implementation of the Hyogo Framework for Action (2009-2011)- Interim*", while the views in a), c),d), and e) are attributed to the JICA Study Team.

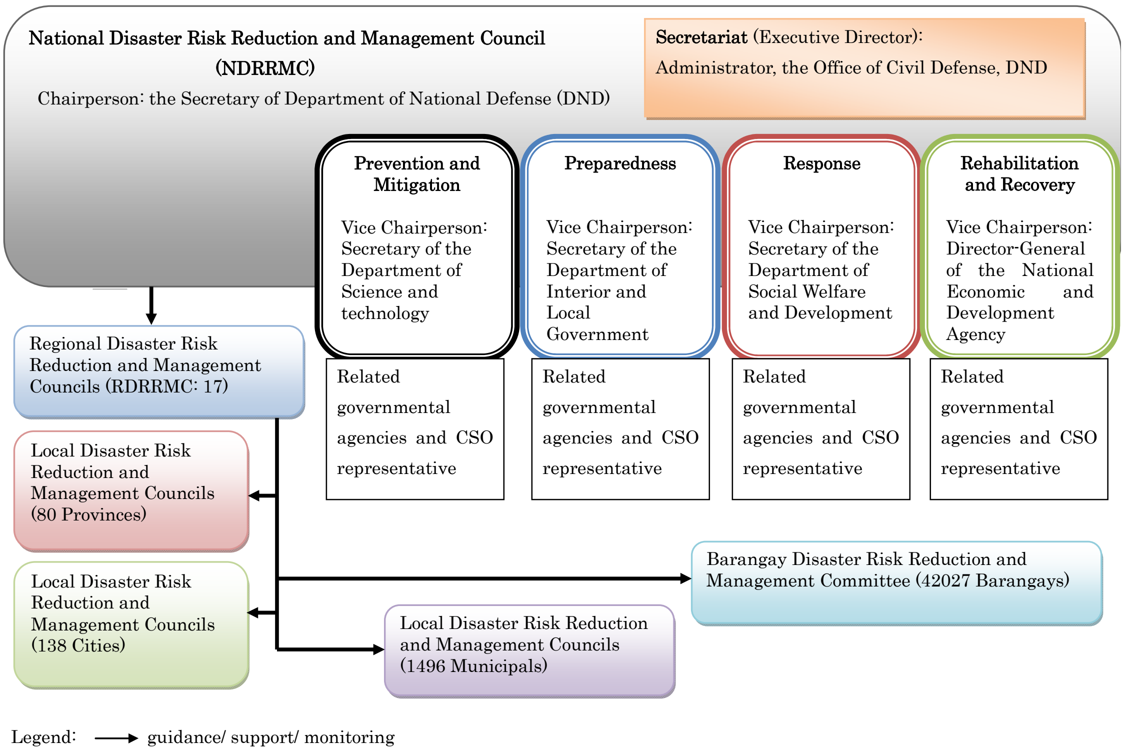
rehabilitation and recovery, with the indication of the expected outcome, outputs, activities, lead agencies, and partners setting timelines from short- to long-term. An implementation plan is also believed to be necessary.

Although local level disaster risk reduction management plans are to be prepared, the guideline for planning is still in preparation.

The Philippines used to have a budget framework called the Calamity Fund, which has been renamed and converted into the Disaster Risk Reduction and Management Fund, according to Republic Act 101211. Thirty percent (30%) of this new fund is allocated for the Quick Response Fund (Stand-by Fund) and is available even for disaster mitigation and prevention activities. At the local level, 5% of expected revenue from regular resources is set aside for the Local Disaster Risk Reduction and Management Fund (LDRRMF), and 30% of which is allocated as Quick Response Fund (Stand-by Fund).

5.7.3 Disaster Management Organization

The National Disaster Coordination Council was renamed as the National Disaster Risk Reduction Management Council (NDRRMC)" by Republic Act 101211. More authority is granted to NDRRMC followed by the increment of its membership from 23 to 43 (including participants from civil society and private sector). The chairperson of NDRRMC is the Secretary of the Department of National Defense (DND) and four vice co-chairpersons are also appointed in charge of four thematic areas mentioned in Section 5.7.2. The Administrator of the Office of Civil Defense (OCD), DND is appointed as the Executive Director for NDRRMC. Figure 5.7.1 below shows the organizational structure in more detail.



Source: JICA Study Team.

Note: Local level disaster risk reduction and management councils are supposed to be established as follows: (1) 17 RDRRMCs (Region) (2) LDRRMCs (80 provinces, 138 cities, 1496 municipalities, (3) BDRRMCs (42027 *Barangays*[27]. RDRRMCs are chaired by the OCD Regional Directors, while other respective level is chaired by the Local Chief Executives.

Figure 5.7.1 Philippines' Disaster Management Structure

5.7.4 Disaster Management at Community Level

The NDRRMP indicates that for Issue 2: Disaster preparedness, the target of capacity development of community including improvement of disaster risk awareness should be set. OCD had planned the International Disaster Management Day in 2009 to promote national public awareness. Every July is set as National Disaster Awareness Month.

Metro Manila, in the National Capital Region, has implemented community support through local government units within the region. "Flood Control *Bayanihan* Zone Alliance[28]", for example, promotes community activities of construction, rescue, and communication in different stages of flood disaster.

5.7.5 Issues and Needs Concerning Organization and Institution

(1) Issues[29]

a) To formulate the implementation plan of NDRRMP;
b) To formulate local disaster risk reduction management plan;
c) To embed the planning process at the local level using NDRRMP as the guide;
e) To merge the disaster risk reduction and climate change plans at the local level;
f) To optimize disaster management fund allocation and use; and
g) To build capacity of local government to lead community-based disaster management.

(2) Needs[30]

a) Preparation of implementation plan based on NDRRMP;
b) Preparation of formulation guideline of local disaster risk reduction management plans and formulation of plans;
c) Establishment of "Disaster Risk Reduction Management Center" in 17 regions equipped with information technology as the law requires;
d) Establishment of the offices for DRRMC; and
e) Establishment of a system of knowledge management of good practice for community-based disaster management and dissemination at local level.

[27] http://www.nscb.gov.ph/activestats/psgc/NSCB_PSGC_SUMMARY_Mar312012.pdf [Accessed: May 31 2012]
[28] Bayanihan = Helping each other
[29] The views in b) and e) are identified by OCD in the interview with the JICA Study Team, while the views in a), c), f) and g) are attributed to the JICA Study Team.
[30] The views in b), c) and d) are identified by OCD in the interview with the JICA Study Team, while the views in a) and e) are attributed to the JICA Study Team.

5.8 Singapore

5.8.1 Disaster Management Law and Policy

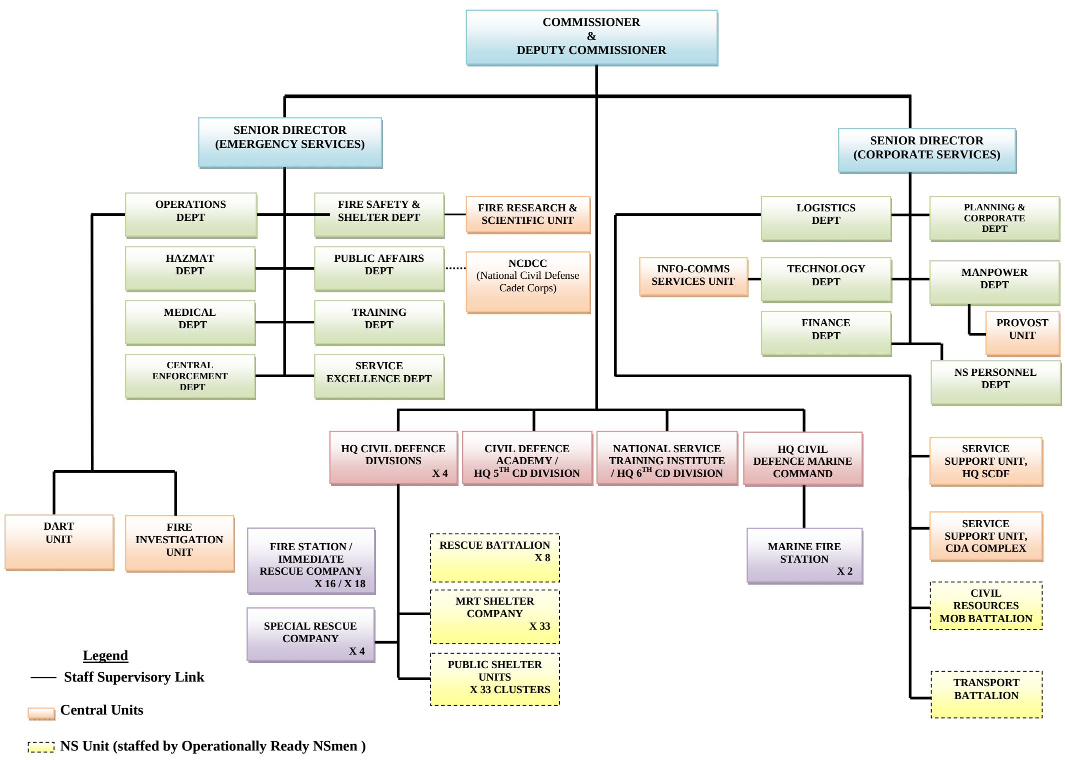
No comprehensive disaster management law exists, only related laws to tackle each disaster. These are the Fire Safety Act (1986) and Environmental Pollution Control Act (2002). In relation with emergency response, there are the Civil Defense Act (1986) and Civil Defense Shelter Act (1997). Policy focus is on urban disaster rather than natural disaster.

5.8.2 Disaster Management Plan and Budget

Singapore has an Operation Civil Emergency (Ops CE) Plan, which is a national contingency plan. As the National Tsunami Response Plan has been developed, it is considered that the expected damages by tsunamis caused by possible earthquakes in South China Sea are just minor levels. As for the latter plan, it is just required to establish an early warning system for tsunamis.

Budget is allocated to ministries and agencies for various activities related to disaster management. All required resources are pooled for the Singapore Civil Defense Force (SCDF), which is Incident Manager (IM) for civil emergencies.

5.8.3 Disaster Management Organization



Source: SCDF (The organizational chart as of November 1, 2011)

Figure 5.8.1 Organizational Structure of Singapore Civil Defense Force

Singapore has all ministries engaged in Home-front Crisis Management System. These are composed of the Home-front Ministry Group, Home-front Crisis Executive Group and Statutory Board. The Home-front Crisis Executive Group chaired by the Permanent Secretary of Home Affairs is in charge of policy level. The SCDF IM is placed for strategic level. Twenty-seven key agencies, including the SCDF itself, armed forces, police, and other ministries are located in tactical level.

The SCDF under the Ministry of Home Affairs is responsible for emergency response to urban disasters including fire, having 5600 staffs (35% permanent staff and 62% full time national service). SCDF also has 8300 stand-by staff as of April 2012.

5.8.4 Disaster Management at Community Level

There are wide ranges of community-based activities. For example, the Community Emergency Preparedness Programme (CEPP) provides basic first aid, one-man cardio-pulmonary resuscitation (CPR) and automated external defibrillator (AED), fire safety and casualty evacuation, emergency procedures, and terrorism.

Communities consist of 87 constituencies in Singapore for CEPP to implement. 48 out of 87 constituencies have been benefitted by CEPP annually.

The Country Emergency Rescue Team (CERT) is formed by community volunteers.

5.8.5 Issues and Needs Concerning Organization and Institution

Basically, Singapore is organized and institutionalized for disaster management, as SCDF is an active player providing leadership role in the activities of the International Search and Rescue Advisory Group organized by the UN OCHA (Office for the Coordination of Humanitarian Affairs)[31]. SCDF, therefore, is able to provide assistance to the ASEAN region such as capacity development training, especially in the area of urban search and rescue operations. Its resources for urban disaster management are rich and very advanced. Singapore is in a position to lead urban disaster issues in the region and will provide assistance to other ASEAN countries in need.

5.9 Thailand

5.9.1 Disaster Management Law and Policy

The Disaster Prevention and Mitigation Act were issued in 2007.

Implementation of HFA is addressed by and materialized into the Strategic National Action Plan for Disaster Risk Reduction (SNAP) 2010-2019, which identifies strategic priorities. Disaster risk reduction is now one of top priorities of the country. The flood disaster in 2011

[31] *RESCUE 995* (2011), Vol. 4, No.12, p.21. (http://www.scdf.gov.sg/content/scdf_internet/en/general/publications/rescue-995/_jcr_content/par/download_a3c8/file.res/Vol_4_No_12.pdf) [Accessed: May 31, 2012]

provided an occasion to review the policy. More solid prevention and mitigation measures are considered.

5.9.2 Disaster Management Plan and Budget

In 2010, the National Disaster Prevention and Mitigation Plan 2010-2014 (NDPMP) was issued. The framework of NDPMP is largely composed of i) management principle, ii) countermeasure procedure, and iii) security threat management & countermeasure procedure. It indicates, as disaster countermeasure procedure, 14 disaster cases and the standing order for each of them.

Using NDPMP as a guideline, it is expected that local DPMPs are supposed to be prepared. The Department of Disaster Prevention and Mitigation (DDPM) provides training opportunities for provinces and districts to prepare local plans.

In light of the flood disaster event in 2011, a contingency plan is also planned to be prepared in April 2012.

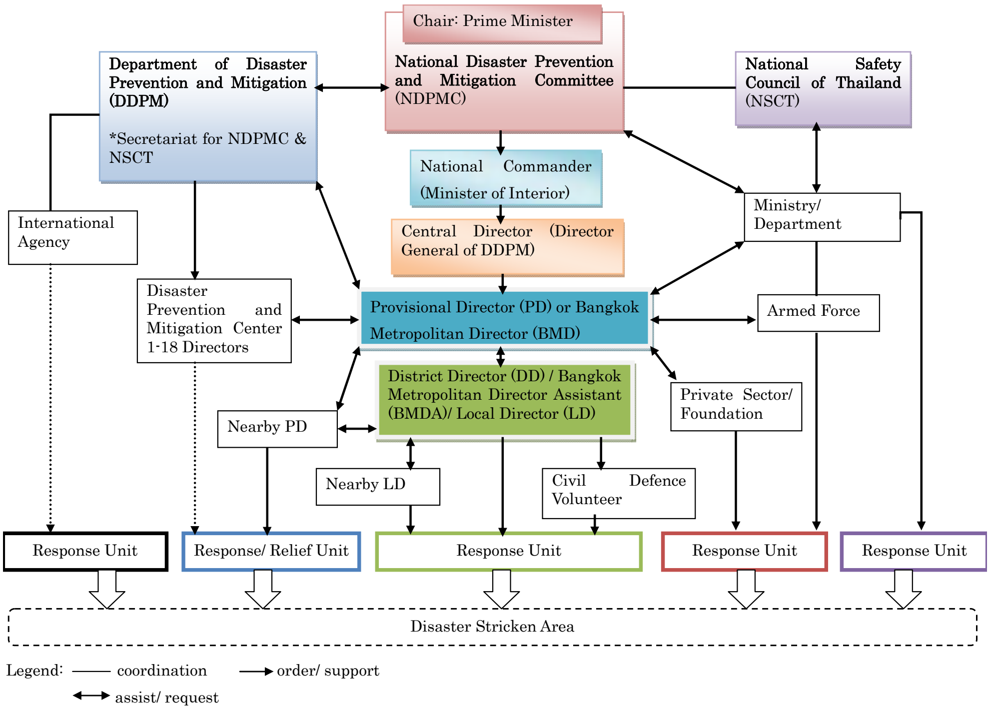
Budget is decentralized since 2002. Each local administration has authority over the use of funds.

5.9.3 Disaster Management Organization

For overall management of disaster, the National Disaster Prevention and Mitigation Committee (NDPMC) are established. NDPMC is chaired by the Prime Minister or his designated Deputy Prime Minister. The Minister of Interior is the first vice-chairman and the Permanent Secretary of the Ministry of Interior is the second vice-chairman for NDPMC. Other members are from the permanent secretaries from the respective ministries, commissioners of the police as well as army and five other experts.

The Director-General of DDPM (under the jurisdiction of the Ministry of Interior) assumes the secretariat function for NDPMC.

At the local level, the Provincial Governor is the Provincial Director responsible for disaster prevention and mitigation operation (Clause 15 of the Act). A chairman of a provincial administrative organization is appointed as the Deputy Provincial Director. DDPM in the local level provides the secretariat function. The same applies to different local levels.



Source: NDPMC "National Disaster Prevention and Mitigation Plan B.E. 2553-2557 (2010-2014)", p.18.

Figure 5.9.1 Thailand's Disaster Management Structure

5.9.4 Disaster Management at Community Level

There are several projects on Community-based Disaster Reduction Management (CBDRM) that have been implemented. For example, JICA has assisted DDPM to be an enabling agency in order to improve the capacity of the local governments and the communities for disaster management through the Project on Capacity Development in Disaster Management.

5.9.5 Issues and Needs Concerning Organization and Institution

(1) Issues[32]

a) To promote local awareness and understanding of disaster risk with the lessons learnt from the flood disaster in 2011;

b) To improve the coordination mechanism (for example, a single command system for water management is not yet established); and

c) To amplify coordination in support of CBDRM.

(2) Needs[33]

a) Provision of training program on disaster management for local government officers in charge of disaster management;

[32] The view in a) is identified by DDPM in the interview with the JICA Study Team, while the views in b) and c) are attributed to the JICA Study Team.

[33] The view in b) is identified by DDPM in the interview with the JICA Study Team, while the views in a), c) and d) are attributed to the JICA Study Team.

b) Preparation of sector plans for roads, irrigation and water resource. And integration of disaster countermeasures of these plans in a coordinated manner;

c) Establishment of coordination mechanism (single command system) especially in the water management sector; and

d) Preparation of CBDRM plans and general-purpose modeling.

5.10 Vietnam

5.10.1 Disaster Management Law and Policy

The Disaster Management Bill has been drafted with the support of the United Nations Development Programme (UNDP). Central ministerial consultation has been completed on the draft, and the feedbacks from provinces are awaited for finalization of the bill.

The finalized bill is to be submitted to the cabinet, and will be discussed and subsequently revised in the national assembly. It is expected to be approved and enacted after the National Assembly is held in March and May 2013.

As it is in the course of revision, the National Strategy for Natural Disaster Prevention, Response and Mitigation to 2020 was issued in 2007. Disaster management is considered from two aspects: (1) emergency response/preparedness, and (2) disaster mitigation. It is prioritized to prevent human loss.

5.10.2 Disaster Management Plan and Budget

The implementation plan of the National Strategy for Natural Disaster Prevention, Response and Mitigation to 2020 was issued in 2009 as the guideline for other ministries/agencies and local governments to apply according to local situations. Provinces prepare local implementation plans following this national framework.

For disaster mitigation, the Department of Dyke Management, Flood and Storm Control (DDMFSC), a leading and responsible agency for disaster management, was allocated 200 billion VND in 2011. However, this is used for dykes in 19 out of 58 provinces. Provinces in Southern Vietnam are not subject for dyke management with DDMFSC budget. The Ministry of Natural Resources and Environment (MONRE) is allocated some budget for establishment of meteorological and hydrological stations. It is believed that the budget allocation for the above aims is not adequate.

5.10.3 Disaster Management Organization

There are two main committees: (1) Central Committee for Flood and Storm Control (CCFSC) (chaired by the Minister of Agriculture and Rural Development, and DDMFSC plays the secretariat function), and; (2) National Committee for Search and Rescue (NCSR) (chaired by the Deputy Prime Minister, Ministry of Defense, and Department of Search and Rescue, the Ministry of Defense plays the secretariat function.

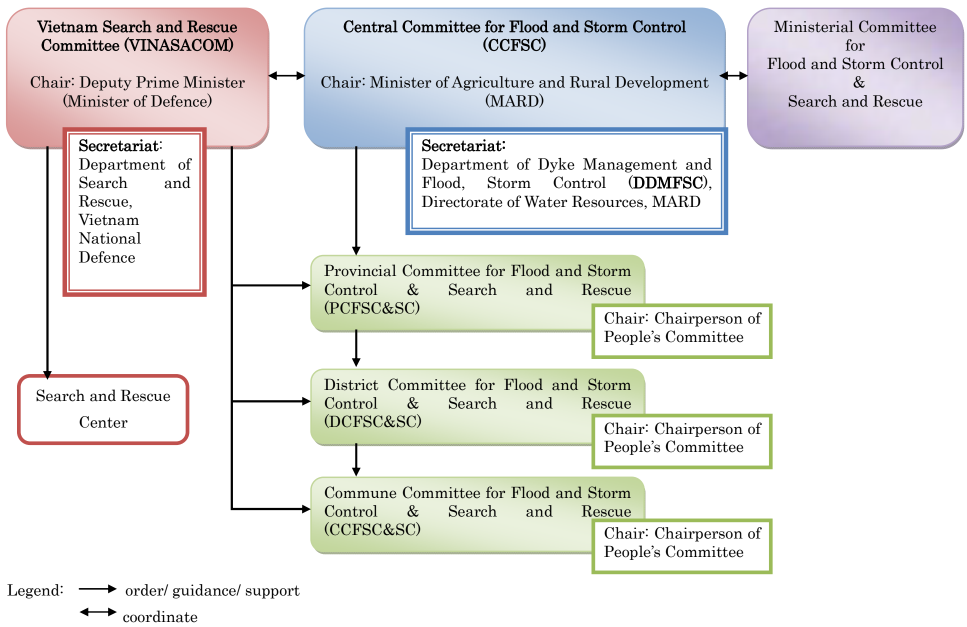
At the central government level, there is also a ministerial committee concerning both flood and storm control and search/rescue.

At the local level, the above two main committees are integrated. Provisional level is named the Provincial Committee for Flood and Storm Control and Search and Rescue (PCFSC&SR). Same applies to the district (DCFSC&SR) and commune (CCFSC&SR) levels. PCFSC&SR is chaired by the chairman of the People's Committee and secretariat office is also located within. The vice-chairman is the Deputy Director of the Department of Agriculture and Rural Development (DARD) in respective province.

The organizational structure of Vietnam's disaster management is shown in Figure 5.10.1 on the following page.

5.10.4 Disaster Management at Community Level

Community participation for disaster reduction management has been emphasised by the Prime Minister's Decision (Decision 1002/QD-TTg) in 2009. Traditionally, however, community engagement in disaster response and recovery/rehabilitation stages is the key principle. The decentralization structure makes it possible for the People's Committees to plan and allocate the budget at the local government level. With the support of external donors and NGOs, it is directed by the Prime Minister's Decision in 2009 that the provinces' implementation plan be prepared to roll out Community-based Disaster Reduction Management (CBDRM) to 6,000 out of 11,111 communes (commune-level sub-divisions)[34] by 2020. The decision also directs that all officers in charge of disaster management at all levels be trained to be capable of CBDRM.



Source: JICA Study Team

Figure 5.10.1 Vietnam's Disaster Management Structure

[34] The number of communes is as of 2010. http://www.gso.gov.vn/default_en.aspx?tabid=466&idmid=3&ItemID=11653 [Accessed: May 31, 2012]

5.10.5 Issues and Needs Concerning Organization and Institution

(1) Issues[35]

a) To formulate the disaster management law (draft) containing multi-hazard arrangements;

b) To address urban disasters caused by flood and high tide (especially in Ho Chi Minh City);

c) To improve the disaster management structure in order to tackle multi-hazards (MARD is the principal disaster management agency focusing on flood disaster); and

d) To prepare a guideline and tools and to spare funds for implementation of CBDRM.

(2) Needs[36]

a) Further revision of the law of disaster management to be compliant to multi-hazards;

b) Preparation of master plans for urban flood disaster and high tide problem for Ho Chi Minh City;

c) Provision of capacity development program for local officials to obtain expertise of disaster management planning and CBDRM; and

d) Standardization of guideline and tools for CBDRM.

[35] All the views are generally attributed to the JICA Study Team apart from a) which was obtained in the discussion with UNDP Vietnam in March 2012.

[36] All the views are attributed to the JICA Study Team.

CHAPTER 6 PRESENT SITUATION OF DISASTER MANAGEMENT AGAINST PREVAILING NATURAL DISASTERS IN ASEAN

6.1 Flood

6.1.1 Brunei

(1) Present Situation of Flood Disaster

Flood including flash floods are considered to be the most frequent disasters in country. It can be observed that the frequency of flash floods is increasing. In general, high intensity rain of one or two hours duration can cause flood up to 1.0m deep in the inland area. Kampong Ayer (a cluster of settlements built on the Brunei River) has about 25% of the population of the capital city is also at high risk of inundation especially when heavy rainfall occurs during high tides period. Several areas in Bandar Seri Begawan have also experienced flooding.

Several areas in Tutong and Belait Districts are considered to the flood prone areas and it is normal that flood in those areas can last for up to one week.

(2) Risk Assessment

The country is composed of four districts. Flood hazard maps for each of the four districts have been developed by the Public Works Department (PWD) under the Ministry of Development.

(3) Monitoring / Early Warning System

A telemetric flood forecasting and warning system (FFWS) is being developed by the PDW in collaboration with the Brunei Darussalam Meteorological Service (BDMS) under the Department of Civil Aviation, Ministry of Communication. In the monitoring system, PWD is in charge of hydrological monitoring while the BDMS is in charge of meteorological monitoring.

A colored staff gauge has been installed by the PWD in the Kianggeh River, a tributary of the Brunei River, for the purpose of providing the public with flood warning information.

The BDMS manages 14 automatic weather stations distributed throughout the county. The rainfall data shown in their website are real time. The BDMS also provides three steps of weather warning.

(4) Preparedness / Prevention and Mitigation

The PWD has implemented various river improvement works in order to secure the discharge capacity of rivers. For Tutong District, one of the most flood prone areas in the country, the Sungai Tutong Floodplain Management Plan was formulated in June 2006. In accordance with the plan, some structural measures such as dam, diversion, widening of river channel, and dredging have been taken to mitigate flood damages.

(5) Emergency Response

Since the country has not suffered from severe floods as compared to its neighboring countries, the public are less concerned on disaster response. In order to raise awareness, concerned organizations have carried out interactions with the public through exhibition, campaign, disaster education, and so on.

6.1.2 Cambodia

(1) Present Situation of Flood Disaster

Cambodia is one of the most flood prone countries in the ASEAN region. About 80% of the country's territory lies within the Mekong River which is known to have large fluctuations of water level between the dry and wet seasons. This has caused a cycle of droughts and flooding almost every year, damaging agricultural production and the livelihood of people. Regarding the most recent flooding, a wide area of the country was seriously suffered from the floods in 2011, as described later.

As well as riverine floods, urban drainage issues in Phnom Penh have been growing. In accordance with the master plan for drainage improvement and flood control in the Municipality of Phnom Penh, which was formulated in 1999, the project for drainage improvement and flood control is currently being implemented with a technical and financial assistance of JICA. However, urban inundation problems have continued due to expansion of urban areas in addition to land development of preservation areas that were designated as retarding basin in the above 1999 master plan.

(2) Risk Assessment

Currently, a risk map covering the whole country is being developed with assistance from the World Bank. The output will be provided to the Emergency Coordination Center, which is also being established. However, this risk map is being prepared based on a large-scale map for the purpose of policy decision to identify priority among target areas.

The Provincial Committee for Disaster Management (PCDM) of Siem Reap intends to develop a flood hazard map based on the Land Management and Administration Project (LMAP), which was completed in 2009 with assistance from the World Bank.

(3) Monitoring / Early Warning System

Telemetric forecasting systems have been installed in major river basins, namely Stung Treng, Kratie, Prek Kdam, and Kompong Loung basins. There are ten telemetric hydrological stations along the Mekong, Tonle Sap, and Bassac Rivers. They are operated by the Department of Hydrology and River Works (DHRW) under the Ministry of Water Resources and Meteorology (MOWRAM). Once the water level reaches danger level, the DHRW issues a notification to relevant organizations, and posts the warning on their website.

In case of critical flood, a warning is officially issued by the National Committee for Disaster Management (NCDM). It is then transmitted to the provincial, district, and commune committees for disaster management (PCDM, DDCM, and CCDM, respectively) through landline phone, cellular phone, internet-email, and facsimile.

Meanwhile, flash flood information is released through the website of the Mekong River Commission (MRC). It is then analyzed by the Mekong River Commission Flash Flood Guidance (MRCFFG) System. However the forecast accuracy of the said system has been an issue.

(4) Preparedness / Prevention and Mitigation

An integrated plan for flood mitigation has neither been developed at national nor local levels. Under such circumstances, structural measures such as river dikes, ring dikes with pumping stations and dams have been constructed. Currently, many dams are being planned. However, legal systems on the management of water right or reservoir operations have not been arranged.

(5) Emergency Response

At the time of floods in 2011, the Royal Government of Cambodia called on all local authorities and concerned government organizations to increase their vigilance and pay attention to taking necessary measures.

One of the necessary measures was to provide assistance for evacuees who had to stay at evacuation places such as high grounds. The assistance included provision of foods, shelters, and medicines. The armed forces as well as administrative officials and staff of medical teams took turns to be on duty to provide security, safety and healthcare for the evacuees.

Once the flood subsides completely, the local authorities and the armed forces provided affected people with transportations so that they could travel back to their homes.

Although various organizations are concerned to emergency response activities, the Ministry of National Defense plays a key role particularly in the assistance of evacuation activities. However, a system to confirm the completion of evacuation activities has not been established. As for flood fighting activities, sand bags are often set up to avoid expansion of flood areas.

(6) Result of Field Survey on Flooding in 2011

<u>Overview of Flooding in August-September 2011</u>

The flood started in the second week of August 2011 and affected 18 out of 24 provinces of Cambodia. The main cause was a combination of a tropical storm and monsoonal rainfall. According to the Global Disaster Alert and Coordination System[1], this flood was viewed as an extreme event with an estimated recurrence interval greater than 100 years.

Most affected communities were in rural areas. The floods devastated large areas in Cambodia, causing 250 deaths, displacing 51,950 families and destroying 267,184 ha of rice crops (equivalent to 9.4% of the total rice crop area in the country).

[1] http://www.gdacs.org/

Outline of the Field Survey

This flood damage and interview survey was conducted in Siem Reap Province on March 7-8, 2012, with official support from and cooperation with the NCDM, Siem Reap Provincial Office and Banteay Srei District Office.

Findings

- The 2011 flood was the first experience of flash flood in the province. The water level of the Siem Reap River rose 3-4 m within one to two hours, and then the flood water disappeared in six hours.
- Usually people who live along downstream of the Siem Reap River know how to evacuate from floods that occur slowly, as they have experienced in the past. Since this was the first experience of flash flood in the middle-upper area, many people suffered from it.
- Although an early warning was announced through TV and radio, the flood caused 29 deaths in the province. The PCDM had prepared evacuation shelters in advance; however some children were swallowed by flood water on the way to the evacuation areas.
- In addition to local villagers, many tourists visiting the historical temple of Banteay Srey were rescued by helicopters and/or motorboats.
- Wat Damnak Primary School in Siem Reap Town had been closed for two months due to severe inundation. Some flood marks on the wall of the school buildings at the ground level confirmed that the flood water level reached about 0.5-1.0 m high.

(7) Issues and Needs

Based on the above field survey as well as the interview survey with the government offices at the national level, the following key issues were identified:

- Hydropower projects are being promoted by PFI. There is a fear that the risk of man-made disaster increases due to lack of capability of reservoir operations under the circumstances of lack of a system to secure flood function in reservoirs.[2]
- As for structural measures against flood disaster, it is required to conduct maintenance works to secure discharge capacity through excavation of riverbed, rehabilitation of diversion channel, and construction of dikes.[3]
- Along with preventive measures against flood disaster, more evacuation shelters and medical support should be provided as emergency measures.[4]
- Although a flood map is required, it has not been prepared at the provincial level due to inadequate information sources. Development of a database system is necessary.[2]
- To identify the possibility of flash flood as early as possible, it is desirable to install automatic gauging stations even in the tributaries of the Mekong River.[2]
- To solve the urban drainage issues in Phnom Penh, further implementation of project for drainage improvement and flood control will be required.[2]

To solve the above major issues, the following needs are also identified:[5]

[2] The view is attributed to the JICA Study Team.
[3] The view is identified by Siem Reap PCDM in the interview with the JICA Study Team.
[4] The view is identified by NCDM in the interview with the JICA Study Team.
[5] All the views are attributed to the JICA Study Team.

(a) Master Plan Study on Integrated Flood Management in the Siem Reap River Basin

While Siem Reap Province has been prosperous in agriculture, tourism has been a very important source of income for the province. Such important places, tourists as well as local people, should be protected from flood disaster. The flood types confirmed in Siem Reap Province include both riverine floods and flash floods. The affected areas also include the upper and lower reaches. Due to the above two situations, Siem Reap Province is suitable as a case study area for development of an integrated flood management system. This master plan study will also contribute to future formulation of the strategic flood control plan in Cambodia.

In this regard, it is recommended to develop an integrated flood management plan covering the whole basin of the Siem Reap River. It should be a combined plan of riverine flood control, flash flood response, urban drainage management, early warning and evacuation, emergency response, and environmental management.

(b) Study on Flood Disaster Assessment and Management for Special Economic Zones (SEZs)

Although the SEZs in Cambodia have not suffered from severe floods, such as the experience of Thailand in 2011, some foreign companies that have invested in Cambodia are concerned about the possibility of flood. In this regard, the development of high precision flood hazard maps in SEZs is required for the purpose of providing criterion in deciding to advance or to set non-life insurance rating. In some cases, hazard mapping itself may provide some difficulties. Also flood vulnerabilities should be evaluated and authorized. In this regard, it is strongly proposed to conduct the above captioned study.

(c) Study on Flood Disaster Assessment and Management for Economic Corridors

During the flood in 2011, National Highway 5, connecting Phnom Penh and Bangkok, has been inundated. It has been a major obstacle to economic activities. For foreign companies, the soundness of economic corridor is an important factor in deciding whether to invest, and know if damage caused by supply stoppage is covered by insurance. To set the insurance rate, it is required to evaluate the flood hazard and flood vulnerability, and then to estimate the economic flood damage risk. In the above captioned study, it is assumed that a flood hazard map and a vulnerability map are to be developed. Those maps would enable prioritization for road maintenance and improvement.

(d) Introduction of Act for Promotion of Building Multipurpose Dam and Enactment of Reservoir Operation Rules

In Cambodia, there is a law on water resources management in the Kingdom of Cambodia (MOWRAM) including legally-defined reservoir operation rule or allocation of flood control volume for water utilization of dam reservoirs[6]. However, there is still a risk that inappropriate reservoir operation could cause flood damage more frequently in the downstream area if

[6] The information was provided by NCDM.

climate change significantly develops in the future. It will be necessary to conduct a study on the improvement of legal systems in order to enact a reservoir operation rule.

(e) Capacity Development of MOWRAM for Flood Management

At present, MOWRAM has not been able to function adequately as a responsible organization on flood management, though it is stipulated in law. It is required to develop the capacity of MOWRAM in order to carry out integrated flood management nationwide in the near future.

(f) Review of Master Plan for Urban Drainage in Phnom Penh

As mentioned above, urban drainage issues in Phnom Penh have been growing. In order to mitigate inundation damages caused by inadequate urban drainage systems, further implementation of project for drainage improvement and flood control is required. In this regards, it is proposed to review the master plan for drainage improvement and flood control in the Municipality of Phnom Penh.

6.1.3 Indonesia

(1) Present Situation of Flood Disaster

Indonesia has suffered from flooding almost every year at some area in the country. During the last decade, flooding has caused more than 1,800 deaths in total all over the country. There are 5590 main rivers throughout the country and 600 of them have the potential to cause floods.

(2) Risk Assessment

Flood hazard maps of each province have been prepared and updated every year by the Ministry of Public Works (PU) in cooperation with the Meteorological, Climatological and Geophysical Agency (BMKG) and the Geospatial Information Agency (BIG), formerly BAKOSURTANAL.

(3) Monitoring / Early Warning System

The Directorate General of Water Resources (DGWR) under PU is responsible for overall flood management. Based on the Ministry of Public Works Decree No. 12/PRT/M/2006, the BBWS and BWS offices were established in 2006 to manage water resources in particular strategic basins. At present, there are 12 BBWS and 21 BWS offices managing a total of 65 basins.

Each BBWS office prepares guidelines on flood alert every rainy reason. The guidelines indicate institutional arrangement, monitoring network, and flow chart of reporting, coordinating and disseminating warning information. All major rivers have three steps in warning the water level.

In some river basins, telemetric systems for flood forecasting and early warning have been installed and operated by BBWS.

On the other hand, BMKG also has 175 automatic weather stations in the country. BMKG provides information on flood potential areas in Jakarta everyday based on analysis using rainfall data, and also provides flood warning based on rainfall.

(4) Preparedness / Prevention and Mitigation

Based on the master plan on flood control and drainage, various short-term and mid-term programs (2002-2016) are being implemented. Structural measures for flood control such as dams, dikes, diversion channels, retarding basins, and other related river improvement works have been constructed and managed by PU.

(5) Emergency Response

As an institutional system to respond to flood disasters, Flood Operation Community Units (POKOMAS) are organized at each local level office under Ministry of Public Works. The Flood Operation Community Units correspond to Regional Disaster Management Agency (BPBD) at provincial, *kabupaten/kota, kechamatan,* and town/village levels under BNPB at national level. Flood Operation Community Units respond to only flood, while Disaster Management Agency (BPBD) under BNBP respond to all kinds of disaster.

Flood Operation Community Unit at the town/village level, performs as the center of flood response activities and evacuation, and also prepares evacuation centers and necessary equipment.

- Although Ministry of Public Works has developed a manual for preparation of early warning and evacuation system for flood, evacuation plans have been prepared for the limited flood prone areas. This may be because sufficiently detailed flood hazard maps have not been prepared.[7]
- Establishment of FFWS (Flood Forecast and Warning System) is still limited to certain parts of flood prone areas. It is required to establish such systems in other flood prone areas[7].

6.1.4 Lao PDR

(1) Present Situation of Flood Disaster

Most cities and towns of Lao PDR lie along the Mekong River and its tributaries, and are thus prone to flooding due to overflow of dikes during the rainy season. The four major flood prone areas are situated along the main stream of Mekong, namely Vientiane, Thakhek, Savannakhet, and Pakse. Flash floods also occur mainly in the tributaries in the mountainous northern and eastern regions of the country. As for the most recent floods, a wide area of the country seriously suffered from floods in 2011, which are described later.

(2) Risk Assessment

According to the Ministry of Agriculture and Forestry, 10% of paddy fields nationwide are in flood prone areas. A systematic assessment of flood hazard has not been made. However, the preparation of a hazard map is being attempted by the Department of Water Resources (DWR) under the Ministry of Natural Resources and Environment (MONRE) based on information from the Department of Meteorology and Hydrology (DMH), with technical support from MRC. Also, a nationwide hazard map will be prepared with assistance from the World Bank.

[7] The view is attributed to the JICA Study Team.

(3) Monitoring / Early Warning System

Monitoring

There are 13 major river basins in the country. The DMH manages 113 monitoring stations for water level and rainfall in the whole country. Out of 113, 44 stations are telemetric. There are four telemetric and three manual monitoring stations along the main stream of the Mekong River. Data observed by the telemetric systems are sent to the DMH in Vientiane everyday.

Rainfall data and water level data at key stations along the Mekong River and its major tributaries are sent to the Mekong River Commission Secretariat (MRCS) for flood forecasting not only in Lao PDR but also in other MRC member countries.

Early Warning

Flood warning is issued by the DMH based on pre-determined criteria of river water level and rainfall, and is disseminated to the line ministries and provinces as well as to mass media through fax or email. Information is also provided to the public through mass media, website, and verbal communication through the use of a loud speaker.

Warning information on flash floods including landslides, which have been increasing in recent years, are issued when the 12-hourly rainfall exceeds 100 mm. However, a particular monitoring system or warning criteria for flash floods has not been established yet.

A system for issuing an evacuation order has not been established. At present, the National Disaster Management Office (NDMO) is the one to decide each time. The standard operating procedure (SOP) on flood has been recently drafted, and a system on decision making is being organized.

(4) Preparedness / Prevention and Mitigation

An integrated plan for flood mitigation has neither been developed at national nor local levels. However, flood protection dikes, sluice gates, diversion channels, and drainages have been constructed by the Ministry of Public Works and Transportation (MPWT) particularly in major cities located along the Mekong River such as Vientiane Capital, Bolikhamsay, Khammouan, Savannakhet, and Champassak, and along major tributaries.

An integrated management system for reservoir operations has not been put into place. One of the causes of flooding in Savannakhet Province in 2011 was considered to be water discharge released from the hydropower dam located upstream. According to MONRE, they are expected to serve as a coordinating organization for integrated reservoir operation in the near future.

As part of disaster preparedness, a Flood Preparedness Program was implemented by the Lao National Mekong Committee (LNMC), the Asian Disaster Preparedness Center (ADPC) and the NDMO with financial support from GIZ and ECHO. The main activities include, i) awareness-raising and enhancing of people’s capacities, ii) preparation and implementation of programs, and iii) integration of flood preparedness and emergency management into local development plans.

(5) Emergency Response

At present, emergency response activities are initiated by the NDMO. However, a systematic emergency operating system (EOS) has not been prepared. Particular evacuation drills in case of flood have not been carried out.

(6) Result of Field Survey on Flooding in 2011

Overview of Floods in July-August 2011

The impacts of Tropical Storm Haima have compounded with the arrival of Tropical Storm Nock-ten and the beginning of the monsoon season. The two storms claimed 42 deaths and affected 429,954 people or 82,493 households in 1790 villages in 96 districts of 12 provinces. The total damage was estimated at about LAK 1,765 billion (USD 220 million).

Outline of the Field Survey

This flood damage and field interview survey was conducted in the southern region of Lao PDR, Savannakhet, and Khammouan Provinces, on February 28-29, 2011.

Findings

- The disaster management committee for Nasang Village in Savannakhet Province is composed of five members. The mayor of the village receives a flood warning from the local government, and then he disseminates the warning to the villagers. The committee holds a regular meeting to discuss how to move household properties to safer places, how to cultivate lands at higher elevation and so on.
- The residential area of Bandan Village in Khammouan Province had been inundated with a depth of more than 1.5 m for 40 days, though the duration of inundation is normally around one week for ordinary floods. The inundation depth in the paddy field was 1.5-2.5 m deep.
- Topographical condition of Champhone District of Savannakhet Province is quite different from its surrounding areas. Once heavy rain occurs, rainwater flows down toward low-lying land where Champhone District is located. In case of ordinary flood, which occur every year, around 3,000 ha of irrigation area is normally flooded.
- During the 2011 flood, the disaster management committee of Champhone District was not able to provide enough support to villagers due to insufficient budget. However, the committee members patrolled and monitored the water level everyday by utilizing two boats.
- A flood warning was not disseminated to Ban Dong Muong Village in Savannakhet Province, though a warning system has been established at the district level. Though the village has access to TV programs normally, the signal of Lao TV in this area was disrupted due to heavy rains.

(7) Issues and Needs

Based on the above field survey as well as the interview survey with the government offices at the national level, the following key issues were identified:

- An integrated plan for flood mitigation has neither been developed at national nor local levels[8].
- Systematic assessment of flood hazard has not been made[8].
- An integrated management system for reservoir operation has not been set up[8].

[8] The view is attributed to the JICA Study Team.

- Since more than half of the stations are manual type at present, the availability of rapid information is limited. It is required to install adequate telemetric systems in order to forecast a flood event timely. A monitoring system for flash flood forecast has not been established[8].

To solve the above major issues, the following were also identified[9].

(a) Enactment of Reservoir Operation Rules

During the flood in 2011, the reservoir water levels of some large dams utilized for hydropower or irrigation purposes reached dangerous levels due to the long duration and wide range of rainfall. Some of those dams had to release large volumes of water from the reservoirs. And it was reported that the released water caused flood damages in downstream areas. This might have occurred due to the operation of hydropower dams including PFI systems in which the institutions and organizations for river basin management have not been developed. In addition, new hydropower dams are being planned in the country. In this regard, it will be necessary to conduct a study on the improvement of legal systems related to such in order to enact a rule on reservoir operation.

(b) Master Plan Study on Integrated Flood Management in the Mekong River Basin

Although the riverbank is being constructed along the Mekong River around major four cities including Vientiane, it is assumed that urban drainage issues will emerge in some urban cities. In contrast, systematic flood mitigation measures have not been developed for small and medium size cities. As experienced in the Chao Phraya River in Thailand, flood damage may have significant impact on a nation’s economic foundation. Lao PDR is not exempted from such since its major cities are located along the Mekong River. Because of these factors, there is an urgent need to evaluate flood disaster in the Mekong River basin including urban drainage issues, and to formulate a master plan aiming at making cities and rural communities more resilient to flood disaster.

(c) Study on Flood Disaster Assessment and Management for Special Economic Zones (SEZs)

Although the SEZs in Lao PDR have not suffered from severe floods, such as the experience of Thailand in 2011, some foreign companies that have invested in Lao PDR are concerned about the possibility of flood. In this regard, the development of high precision flood hazard maps in SEZs is required for the purpose of providing criterion in deciding to advance or to set non-life insurance rating. In some cases, hazard mapping itself may provide some difficulties. Also flood vulnerabilities should be evaluated and authorized. In this regard, it is strongly proposed to conduct the above captioned study.

[9] All the views are attributed to the JICA Study Team.

6.1.5 Malaysia

(1) Present Situation of Flood Disaster

Flood has been recognized as a disaster that is relatively frequent in the country. In December 2007, floods occurred in a wide extent of the country, particularly at Northeast Kelantan, Central Pahang, and Southern Johor Provinces, due to heavy rains. Such floods caused 33 deaths and affected 158,000 people. In recent years, the occurrence of flash floods in urban areas has increased due to urban development.

(2) Risk Assessment

The Department of Irrigation and Drainage (DID) under the Ministry of Natural Resources and Environment (MONRE) is responsible for overall flood management. The DID has categorized three types of flood maps, namely inundation map, flood hazard map, and flood risk map. Inundation maps have been completely developed through site observation and satellite images. Flood hazard maps for 12 areas have been prepared by using hydro-dynamic models with input of hydrological and hydraulic data. Development of flood risk maps will be started soon by adding vulnerability data to flood hazard maps.

(3) Monitoring / Early Warning System

Flood forecast and weather forecast are made by the DID and the Malaysian Meteorological Department (MMD) under the Ministry of Science, Technology and Innovation (MOSTI), respectively.

The Klang Valley basin where Kuala Lumpur is located has been recognized as an important area due to the high population therein. The first FFWS was thus established in this basin. At present, the forecast accuracy is 80-85%, and the model is being improved with a goal of 90% accuracy.

The FFWS in the Muda River basin was completed in 2010. This system is able to forecast the flood condition two days in advance. Radar rainfall data observed by the MMD are also incorporated into the system. Currently, similar systems are being established in the areas of Pahang, Kelantan, and Johor, and then will be adopted in the areas of Padas, Dungun, and Sarawak in the future.

The above FFWS is centrally managed at the National Flood Monitoring Center located in the headquarters of the DID. Warning information automatically issued by the system is transmitted to authorized officers of the DID through short message service (SMS). Furthermore, information such as river water level and rainfall data are uploaded in respective websites for disclosure to the public and concerned organizations.

(4) Preparedness / Prevention and Mitigation

During the past few decades, various flood mitigation projects have been completed in order to mainly increase the discharge capacity of rivers. The major projects are summarized in Table 6.1.1 below.

Table 6.1.1 Major Projects for Flood Mitigation in Malaysia

Project Name	Objectives	Implemented Measures
SMART (Stormwater Management and Road Tunnel)	Mitigation of drainage issues due to heavy rain in Kuala Lumpur	Construction of 9.7 km long tunnel used for both flood diversion and highway
Batu Jinjang Ponds and Related Diversions Project	Mitigation of drainage issues due to heavy rain in Kuala Lumpur	Construction of weirs, widening of existing diversion, construction of new diversion, expanding of existing retarding basin
Sungai Muda Flood Mitigation Project	Flood mitigation in the Muda River basin	Widening of the Muda River channel, construction of dikes, sluices and weirs
Sungai Perai Flood Mitigation Project	Flood mitigation in the Perai River basin	River improvement works including deepening, widening and re-alignment, construction of dikes and tidal gates
Bertam - Kepala Batas Flood Mitigation Project	Flood mitigation in Bertam / Kepala Batas areas	Improvement of existing drainage system, construction of retarding basin and dikes

Source: DID

There are 15 dams under the management of the DID. Out of 15 dams, 7 dams have flood control capacities. Also a number of hydropower dams and water supply dams are operated by other ministries. Although the National Security Council (NSC) is responsible for coordination of water volume released from each dam during flood, an integrated rule has not been prepared yet. In addition, there are some reservoir operation rules that are no longer applicable in old dams.

(5) Emergency Response

The SOP during floods was formulated by NSC in June 2001. Also the Disaster Aid and Management Committee called JPBBN have been established at the national, provincial, and district levels. Evacuation plans have been prepared by each district.

Disaster education and awareness campaigns are implemented by concerned organizations and the Red Cross.

(6) Issues and Needs

- Review of old reservoir operation rules and introduction of a legal system on reservoir operation rules[10].
- Implementation of measures for urban drainage issues in developed areas[10, 11].
- Implementation of flood mitigation projects for rivers with improvement levels not satisfying the standard return period of a 100-year flood[11].

6.1.6 Myanmar

(1) Present Situation of Flood Disaster

1) Flood in Myanmar

Flood is one of the major hazards in Myanmar, accounting for 11% of all losses by disasters (according to the Hazard Profile of Myanmar, 2009). It adversely affects all aspects of human activities not only humanitarian aspects but regional and national economic activities. Flood in

[10] The view is attributed to the JICA Study Team.
[11] The study on integrated urban drainage improvement for Melaka and Sungai Petani in Malaysia: Final Report

Myanmar usually occurs in three periods: June, August, and late September to October with the largest intensity arriving in the peak monsoon season of August.

Floods in Myanmar can be classified into the following four types:

- Riverine floods along rivers,
- Flash floods on the upstream side of rivers in mountainous areas, caused by concentrated heavy rainfall striking at upstream regions of river basins in a short period of one to three days,
- Localized floods in urban area due to a combination of such factors as cloudburst, poor infiltration rate, poor drainage infrastructure, (and also possibly due to climate change, urbanization, heat island effect); and in rural areas due to decrepit of dams, dykes and levees,
- Floods due to cyclones and storm surges in coastal areas.

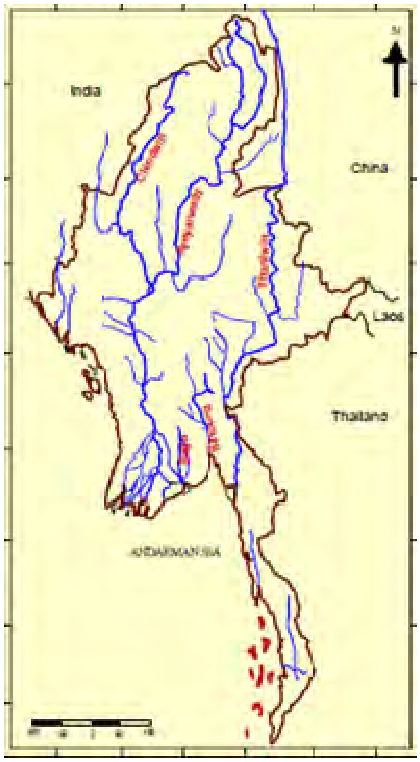
Among them, riverine floods most commonly occur in monsoon troughs or low pressure waves during the monsoon seasons, resulting in intense rainfalls to river catchments.

2) Overview of Floods in 2011

Myanmar has five major rivers, which generally flow from north to south (Ayeyarwady River: 1789 km, Chindwin River: 901 km, Thanlwin River: 1,223 km, Sittoung River: 407 km, and Bago River: 331 km). During the monsoon of July to October 2011, heavy rainfall due to a tropical storm and low pressure waves triggered riverine floods and flash floods all over the country. River levels monitored were described as follows, according to documentation provided by the local authority (Department of Meteorology and Hydrology, DMH):

Thanlwin River (Hpa-an observation station): Water level exceeded the alert level by 175 cm, and stayed at that level for about 26 days (August 1-26). This flood was the second highest flood in historical records (1969-2011).

- *Sittoung River (Maduak observation station)*: Water level exceeded the alert level by 128 cm and stayed at that level for 67 days (August 2-October 9).
- *Bago River (Bago observation station)*: Water level exceeded the alert level by 50 cm. This was the highest recorded flood during the last 47 years (1965-2011).



Source: DMH

Figure 6.1.1 Major Rivers

The floods reported in 2011 are shown in Table 6.1.2 below.

Table 6.1.2 Floods in 2011

Area	Cause/Period	River	Flood Type	Flood Situation / Damage
Ayeyarwady Region	Heavy rainfall due to monsoon in July	Ayeyarwady River	Riverine flood	Occurred in six townships and caused damages to households and farm lands
Bago Region	Heavy rainfall due to monsoon in July	Bago River	Riverine flood	Inundation of about 90-210 cm at Bago township, and flooded the highway at 60-90 cm depth
Kayin State	Heavy rainfall due to monsoon from June to October	Thanlwin River	Riverine flood	Occurred six times at Hpaan Township and caused severe damage to households and paddy fields
Rakhine State	Heavy rainfall due to monsoon in July	No detailed information	Riverine flood	Severe damage to households at eight townships
Magway Region *	Intense rainfall due to Tropical Storm 2 in October	Tributary stream of Ayeyarwady River	Flash flood	Occurred at four townships of Pakkoku District and caused severe damage to ***human lives***, properties and ***public infrastructure***
Sagaing Region	Intense rainfall due to Tropical Storm 2 in October	Tributary stream of Chindwin River	Flash flood	Relatively small damage as compared with the abovementioned Magway Region flooding
Manalay Region	Intense rainfall due to Tropical Storm 2 in October	Tributary stream of Ayeyarwady River	Flash flood	Relatively small damage as compare with the abovementioned Magway Region flooding

Note: * Site reconnaissance was carried out in Magway Region.

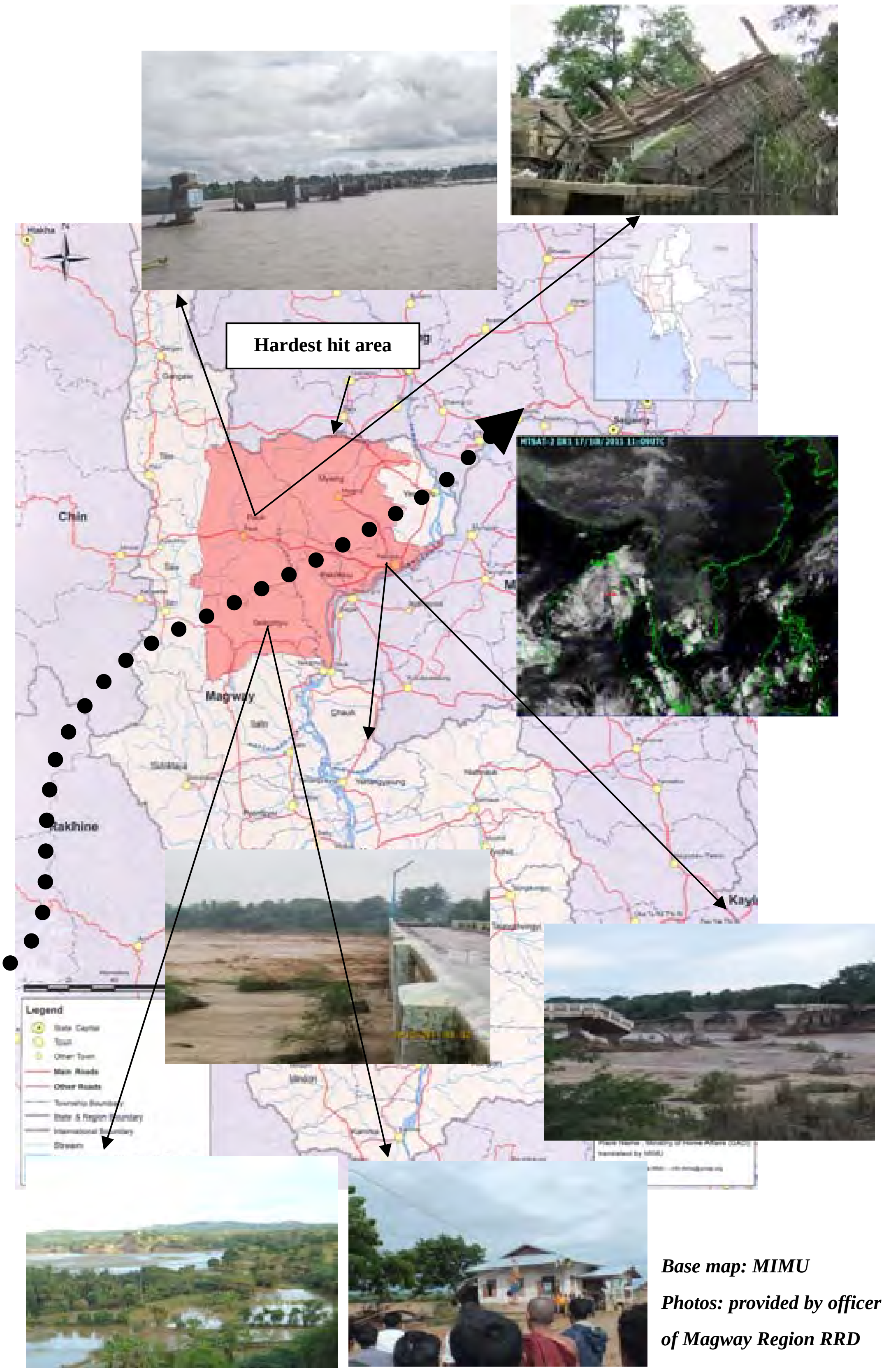
Source: JICA Study Team based on local documents

3) Site Reconnaissance and Interview Survey

The JICA Study Team chose the Magway Region for site reconnaissance because of the enormous damage to public infrastructure and casualties which ensued during the flood event in the said region.

Magway Region is located at the central part of Myanmar. “Tropical Storm 2”, which made landfall near the Myanmar-Bangladesh border on October 19, brought heavy rains. The most severe rainstorm was recorded in Pauk Township. According to the Magway Region Relief and Resettlement Department (RRD) of the Ministry of Social Welfare, Relief and Resettlement, the daily rainfall on October 19 and 20 were 56 mm and 190 mm, respectively. The intense rainfall triggered flash floods in several areas, and Pakokku District of Magway Region had been hit the hardest.

Pakokku District is composed of Pakokku, Yesagyo, Myaing, Pauk, and Seikphyu Townships. Its area is 8300 km^2, and the number of households is 199,125 with a population of about 1.53 million. Of the total population, 15% resides in urban areas and the remaining 85% in rural areas. The main industry in this region is agriculture and livestock. In Pakokku District, the four townships, excluding Yesagyo, were the worst affected areas. The JICA Study Team conducted site reconnaissance and the interview survey at Pakokku, Pauk, and Seikphyu Townships.



Base map: MIMU

Photos: provided by officer of Magway Region RRD

Figure 6.1.2 Flooding on October 20 at Pakokku District

4) Characteristics of the Magway Region Flood

Flash floods in the Pakokku District occurred at Shwe Chaung (the Shwe River) and Yaw Chaung (the Yaw River), which are tributary streams of the Ayeyarwady River. According to the interview with an officer of the Magway Region RRD and the village mayor of Tha Hpan Taunt Village, this kind of flood is the first time in the last four decades. The water level showed rapid rise in a very short time, and then decreased within a few hours.

In the case of Tha Hpan Taunt Village of Seikphyu Township, the flood alert started at around 22:00 of October 19. The flood started in the village at around 0:00 of October 20, and then the water level increased rapidly to about 2.5 m within a short time. Then, it decreased rapidly by 8:00 of the same day. In the case of Pakokku Township, the water level of the Shwe River increased rapidly at around 5:30 of October 20. Then at around 6:30 the flood washed away several houses located along the riverbank. The water level started to decrease during the same day.

5) Damages to Pakokku District

As shown in Table 6.1.3, approximately 36,000 people in Pakokku District have been affected with about 150 casualties and about 2500 totally destroyed houses. Public infrastructure such as bridges, roads, railways, and, agricultural facilities have also been damaged. Three bridges with lengths of about 250-450 m collapsed in Pakokku and Pauk Townships. Some hours later after the flooding began, the water level started to decrease. There was no water in the river next day.

Table 6.1.3 Situation of Damages at Pakkoku District

Unit: MMK

Place	Houses			Dead/ Missing	Damaged Schools	Damaged Livestock[1)]	Affected People	Damaged Amount[2)]
	Original	Flooded	Damaged					
Pakkoku	4,195	1,170	384	112	-	392	2,523	832
Myaing	4,660	354	89	7	-	334	1,730	543
Pauk	6,993	2,775	380	21	2	404	12,381	1,267.5
Seikphyu	4,868	3,659	1,290	11	8	1,566	19,371	1,1004
Total	20,716	7,958[3)]	2,128[4)]	151	10	2,696	35,734	13,646.5

Note: 1) Numbers of animals (cow, sheep, goat, pig, hen)
2) x MMK 100,000: supposed loss of houses, personal properties, and livestock
MMK 1 = JPY 0.1 (according to average exchange rate of 2011)
Source: JICA Study Team based on local authorized documents

Construction of new Shwe Chaug Bridge (Pakokku Township)

Temporary bridge at the affected site (Pauk Township)

Village mayor of Tha Hpan Taunt shows increased water level

Figure 6.1.3 Photos of Site Reconnaissance (Photo: JICA Study Team)

(2) Risk Assessment

1) Current Situation

In the whole country, 48 townships were designated as flood prone townships based on rainfall and past flood events (according to the Hazard Profile of Myanmar, 2009). The Irrigation Department of the Ministry of Agriculture and Irrigation is the agency responsible for conducting hazard mapping. It was reported that the department did a study on hazard mapping for Bago Township with technical assistance from ICHARM and JICA. However, there are still no hazard maps for the entire country.

2) Issues and Needs

It is necessary to conduct flood risk assessments through flood hazard mapping for major cities in the country. It is also required to have proper data acquisition and a recording system/mechanism (possibly utilizing a database system), and to accumulate not only daily records but also historical data of past events in order to conduct accurate analysis[12].

(3) Monitoring / Early Warning System

1) Current Situations

The DMH under the Ministry of Transportation is mainly responsible for flood monitoring, weather forecasting and issuance of early warning. According to DMH documents, observation stations under DMH control include 63 metrological stations, 39 metrology and hydrology stations, 17 agro-meteorological stations, eight aeronautical meteorological offices, and two tide gauge stations. The data center is in Naypyitaw, also the location of the DMH's head office. Data from each observation station at upper Myanmar and lower Myanmar are collected at Mandalay and Yangon, respectively, and then sent to the Naypyitaw head office. The 27 metrological stations regularly send data to the Global Meteorological Observing System every three hours. On the other hand, the sampling interval of hydrological observations is thrice a day.

The Meteorological Division issues meteorological information, warnings, news, alerts, and special forecasting in preparation of a natural disaster. At the same time, the Hydrological Division is responsible for issuing daily river water levels and flood forecast for areas along the following eight major rivers: Ayeyarwady, Chindwin, Sittaung, Thanlwin, Dokehtawady, Bago, Shwegyin, and Ngawun. Flood warning is issued when the water level rises 1 m below the alert level. This warning is issued one to three days in advance for areas in the upstream of the major rivers and other small rivers, and two to five days in advance for areas in the middle and lower reaches of the major rivers. Then, a flood bulletin is issued when the water level reaches or exceeds the alert level and would be discontinued until the level goes below the alert level.

[12] All the views are attributed to the JICA Study Team.

Whenever warnings are issued from the River Forecasting Section (RFS) of the DMH, messages are sent to the respective stations by telephone or single side band (SSB) transceiver. As soon as the head of each station receives the warning message, he immediately informs the local authorities and other related departments in order to carry out the necessary action. At the same time, warnings are announced to the public through radio and television as well as newspapers. If the expected flood is judged to be severe, the warnings would be broadcast more frequently (every three hours) through the Myanmar Broadcasting Services (TV and radio).

2) Issues and Needs

Most of the observation stations are in manual operation and it is an important issue to improve the accuracy of the forecasting and warning system. For more effective forecast and early warning, the following are needed:

- to install the telemetry system for upstream stations and mountainous area, [13]
- to install more AWS stations, [13]
- to install the siren warning system at flash flood area, [14]
- to update software in hydrological model of DMH, [13]
- to improve flash flood forecasting system, [13]
- to develop medium-term technical human resources for DMH[13]
- to analyze past accumulated data[14] and,
- to establish data base system[14]

Moreover, in order to minimize the loss of human lives, the following are necessary[15]:

- introduction of efficient community channels,
- improvement of warning communication and dissemination systems in flood prone areas,
- establishment of flood detection systems such as CCTV monitoring systems.

(4) Preparedness / Prevention and Mitigation

1) Current Situation

The chief agency for flood risk mitigation in the country is the Irrigation Department (ID) under the Ministry of Agriculture and Irrigation (MAI). According to interview results with the MAI, the ID is now operating multipurpose dams and maintaining embankment systems at 14 sites for protection of agricultural lands and irrigation facilities. However, at present conditions, the ID may not have sufficient capacity with regard to dams, particularly to control floods, formulate rules for reservoir operations, and monitor dam safety. The ID and the Forest Department are cooperating with each other to undertake conservation and reforestation activities in important watershed areas to minimize flood hazards.

[13] The view is identified by DMH in the interview with the JICA Study Team.
[14] The view is attributed to the JICA Study Team.
[15] All the views are identified by Magway local authority in the interview with the JICA Study Team.

Another issue regarding the flood problem in the country that should be importantly considered is the heavy siltation in major waterways. It was reported that about 300 tons of silt gets deposited into the Ayeyarwady River annually (according to the Hazard Profile of Myanmar, 2009), therefore dredging in major waterways needs to be conducted as well as watershed conservation.

In addition, the Ministry of Health (MOH) has identified, in close association with the DMH, 48 flood prone townships in the country for their planning. As community level initiatives, Myanmar Red Cross Society is the leading force in implementing capacity building programs for community-based flood management in selected flood vulnerable areas in the country. Then, the RRD conducts disaster management training at the regional and state levels alternatively to educate people on disaster preparedness and management.

2) Issues and Needs

Disaster prevention and mitigation planning in urban cities including Yangon are necessary based on flood risk assessment. Especially, there is urgent need to conduct flood risk assessment and formulation of a business continuity plan (BCP) for the newly planned construction of an industrial complex in Yangon.[16]

Though the ID is responsible in protecting agricultural lands and irrigation facilities from flood, it is not clear which agency is responsible for flood management in urban areas. Therefore, it is necessary to establish a comprehensive and unified watershed management system/mechanism that shall encompass not only rural areas, but urban areas as well, within a watershed.[17]

For disaster mitigation, both structural and non-structural countermeasures are to be implemented such as the following:

- Improvement of flood early warning system,[18]
- Promotion of public education, awareness and advocacy, and [19]
- Training of emergency evacuation, emergency drills, and so on[20].

(5) Emergency Response

1) Current Situation

The key agency for emergency response is the RRD, wherein an emergency operations room is being established. With regards to the occurrence of a disaster, the RRD shall be in a position for coordination with other sub-committees and agencies such as the fire services department, Myanmar police force, military force, and health department for search, rescue, and relief. The RRD also is responsible for resettlement and rehabilitation of disaster victims. The affected people are provided with food and other relief materials, such as blankets, towels,

[16] The view is identified by YCDC in the interview with the JICA Study Team.
[17] The view is attributed to the JICA Study Team.
[18] The view is identified by DMH in the interview with the JICA Study Team.
[19] The view is attributed to the JICA Study Team.
[20] The view is attributed to the JICA Study Team.

bowls, etc. These relief materials are stored in 19 warehouses including a Central Warehouse in Yangon under the management of RRD.

MOH and Myanmar Red Cross Society provide first aid and psychosocial support to victims in emergency shelters. The MOH is also responsible for collecting, monitoring, and storing data on the injured, dead, and missing, and those with diseases. After a disaster, the Public Works of the Ministry of Construction is responsible for reconstruction of public infrastructure and establishment of new towns for resettlement of victims. At the same time, the Ministry of Irrigation is responsible for drilling works for setting up tube wells at campsites. Also, the Myanmar Agriculture Service (MAS) distributes quality seeds and replacements of agricultural tools to farmers.

2) Issues and Needs

- To conduct capacity building for officers related to the emergency operations room;[21]
- To increase the number of warehouses in the whole country and relief materials; and [22]
- To construct new towns in a systematic way for post-disaster resettlement of victims[23].

6.1.7 Philippines

(1) Present Situation of Flood Disaster

The Philippines nationwide is prone to flooding due to tropical storms and typhoons. According to the Office of Civil Defense (OCD), 1557 deaths and more than 3.5 million affected people were reported due to 12 tropical storms and typhoons which occurred in 2011. The number of people whose lifestyles were affected by flood and the monetary amount of flood damages are increasing over time.

(2) Risk Assessment

Various hazard maps for 22 provinces for earthquake, tsunami, landslide, flood, and volcano have been developed based on the existing maps prepared by the National Mapping and Resource Information Authority (NAMRIA) through the READY Project[24], which was funded by the UNDP and AusAID. The project was initiated by the National Disaster Risk Reduction and Management Council (NDRRMC) in cooperation with other organizations, and was completed in December 2011.

On the other hand, the DREAM[25] Project, which is one of 8 components of the NOAH[26] Project launched by the Department of Science and Technology (DOST), plans to conduct flood simulation for 18 river basins as well as improving meteo-hydrological network and 3D mapping by the use of a radar profiler.

21 The view is attributed to the JICA Study Team.
22 The view is identified by RRD in the interview with the JICA Study Team.
23 The view is attributed to the JICA Study Team.
24 Hazard Mapping and Assessment for Effective Community-Based Disaster Risk Management
25 Disaster Risk Exposure and Assessment for Mitigation
26 Nationwide Operational Assessment of Hazards

(3) Monitoring / Early Warning System

The FFWS operated by PAGASA (Philippine Atmospheric, Geophysical and Astronomical Services Administration) under DOST have been established for the strategic 5 river basins of Pampanga, Agno, Bicol, Cagayan and Marikina. Out of those PAGASA's systems, only Marikina's system was developed with an assistance of KOICA, and is outside the control of HMD (Hydro-Meteorological Division) of PAGASA. In addition, the Marikina river basin has two or more systems and/or monitoring equipments such as a flood forecasting system called EFCOS [27] under the control of MMDA (Metro Manila Development Authority), and monitoring equipments developed by Advanced Science and Technology Institute (ASTI) under DOST. As for the other areas except for the above 5 basins, warning is issued in the form of rainfall.

Out of the above basins, the systems in Bicol and Cagayan have not been functioning well due to malfunctioning of gauging devices, inadequate update of H-Q curves, and inappropriate setting of warning water levels. Rehabilitation works have just been started in the Bicol River basin with Japan's non-project grant aid.

Once flood forecasting is completed by PAGASA, the result is reported to the OCD and concerned organizations. There is an attempt to disseminate warning information issued by the OCD to the public through local government networks, while real-time information is also available through PAGASA's website, mass media, and SNS.

(4) Preparedness / Prevention and Mitigation

Various structural measures including construction of dams and river improvement works have been implemented in accordance with Medium Term Philippines Development Plan.

During floods, discharge released from reservoirs is controlled based on discussions among members of Joint Operation and Management Committee, which is chaired by the director of PAGASA. Regarding dam operation, capacities for the issuance of forecasting and warning in the lower to middle reaches of Pampanga, Agno, Cagayan and Bicol river basins have been improved through the technical cooperation project "Strengthening of Flood Forecasting and Warning Administration Project", which was conducted for two years from 2004. However, capacities for forecasting and warning in the upper reaches are not enough, and there are still issues on appropriate forecasting and warning for whole river basin. In this regard, to enhance capacities for forecasting and warning for while river basin by improving capacities for in the upper reaches, "Strengthening of Flood Forecasting and Warning System for Dam Operation" is being conducted from October 2009 to December 2012 with technical and financial assistance of JICA.

Land use regulation is stipulated in some areas for the purpose of preventing encroachment in sandbars along river banks. However, recognition and regulation by local governments are not

[27] Effective Flood Control Operation System (EFCOS consists of two phases, the first and the second phases were completed in 1992 and 2001, respectively. Although initially EFCOS project was implemented as a project of Department of Public Works and Highways (DPWH), it was transferred to MMDA in 2002.)

adequate. Due to this, during the tropical storm in 2011, a whole village was flushed away by floods in some areas in Cagayan de Oro and Iligan cities. Various structural measures including construction of dams and river improvement works have been implemented in accordance with the Medium-Term Philippine Development Plan.

During floods, discharge released from reservoirs is controlled based on discussions among members of the Joint Operations and Management Committee, which is chaired by the Director of PAGASA. Each dam has its own reservoir operation rule, however it has been pointed out that some reservoirs have not been operated in accordance with the rule.

Land use regulation is stipulated in some areas for the purpose of preventing encroachment in sandbars along riverbanks. However, recognition and regulation by local governments are not adequate. In this regard, during a tropical storm in 2011, entire villages were flushed away by floods in some areas in Cagayan de Oro and Iligan cities.

(5) Emergency Response

As exemplified by floods mentioned below, the promotion of community-based disaster management had exerted an effect on the reduction of flood damages.

In May 2009, the province of Zambales was devastated by flooding due to passage of a storm but no casualties were recorded. This was mainly attributed to the community based flood early warning system (CBFEWS) in place.

In December 2011, Surigao del Sur recorded 2 casualties compared to Cagayan de Oro and Iligan City (more than 1,000) due to the passage of the tropical storm Washi. In 2005, CBFEWS was established under the UNDP Ready project. People in the area still remember the lessons during the flood drills conducted. LGUs immediately convened the local DRRMC in anticipation of storm Washi.

(6) Issues and Needs

- There are a number of areas that require establishment of flood early warning systems and flood control project implementation with structural measures. The biggest challenges is how to realize National Flood and Hazard Forecasting and Mitigation Program, which was initiated by presidential decree, in the major 18 river basins that were newly targeted by DOST.[28].
- With respect to dam operations, there are needs of advisories for various studies on possibilities of reviewing the dam operation rules, reallocating flood control capacity, and introducing a legal system with regards to reservoir operation rules[28].
- As part of non-structural measures, it is necessary to strengthen land use regulations through capacity development of local government for flood management, relocation of illegal settlers residing in river lands, and review of certification system for land use[28].

28 The view is attributed to the JICA Study Team.

6.1.8 Singapore

(1) Present Situation of Flood Disaster

Singapore has rarely suffered from riverine floods, while flash floods have occurred relatively frequently due to heavy rainfall. Flash floods occasionally affect the major roads in the country such as Orchard Road.

(2) Risk Assessment

Flood risk maps covering the whole country are currently being developed. On the other hand, 58 flood prone areas have been identified, and the map is available online. The total area was estimated at 49 ha.

(3) Monitoring / Early Warning System

The responsible organizations for flood monitoring include the Meteorological Service Singapore (MSS) for meteorological observations, and the Public Utilities Board (PUB) for hydrological observations.

For the purpose of flood monitoring the MSS provides warnings of heavy rainfall as well as real-time rainfall data taken from its network of 64 rain gauges around the island. In contrast, the PUB has 150 water level sensors for monitoring of drainage systems. Warnings are disseminated via SMS, fax, and the internet.

(4) Preparedness / Prevention and Mitigation

The PUB adopts three key strategies for flood management, namely, i) providing adequate drainage ahead of new developments, ii) implementing flood protection measures, and iii) continuous drainage improvement in flood prone areas. In accordance with the said strategies, necessary measures such as drainage systems and flood barriers have been developed and maintained.

6.1.9 Thailand

(1) Present Situation of Flood Disaster

1) Flood in Thailand

The rainy season in Thailand starts from June and ends in October. Approximately 80% of the total rainfall occurs during the rainy season. Heavy rainfall caused by monsoons and storms leads to huge volume of runoff, resulting in frequent flooding in the country. Flood has been the most devastating disaster in the country.

According to 30 years of statistics data, the average number of flood occurrences and causalities per year are 1.48 times (most frequent disasters) and 67.1 persons, respectively. Flooding is the foremost disaster in Thailand with an economic average annual loss (AAL) of USD 164.4 million, followed by tsunami with USD 50.6 million, storms with USD 36.8 million, and drought with USD 20.5 million. (The said data are according to the Synthesis Report on Ten ASEAN Countries Disaster Risks Assessment, 2010).

During the past 45 years, forest area has decreased from 171 million rai (1 rai = 1,600 m^2) in 1961 (53% of the total land area) to 105 million rai (33% of the total land area) in 2004 (according to the Master Plan for Disaster Prevention and Mitigation from Flood, Storm, and Landslide, Department of Disaster Prevention and Mitigation). The dramatic loss of forest area has led to slope failures and/or landslides in mountainous areas which cause the silting of ponds, dams and rivers. It can be considered that decrease in the capacity of water control of ponds, dams, and rivers is also one of the reasons for the frequent occurrence of floods in the country. Moreover, floodplains, which have played an important role in controlling water in the past, have been transformed to residential areas of communities, cultivated lands, industrial areas/facilities, etc. This has resulted in a dramatic decrease of storage capacity along rivers, and is also one of the reasons for extensive and frequent flooding in the country.

Table 6.1.4 Past Major Floods in Chao Phraya River Basin

Year	Return Period (Approximate)	Flood Area (km^2)	Damage Cost (THB million)	Remarks
1983	3	11,900	6,600	Especially in Bangkok and its vicinity, several areas were flooded over three months. JICA carried out countermeasures based on the Integrated Flood Prevention Plan of Japan.
1995	30	6,140	7,761.11	A JICA Master Plan Study was conducted after this event.
1996	5	7,120	2,028.91	-
2002	15	5,080	1,914.63	-
2006	20	19,000	4,167.16	The worst event in the past 62 years. The number of deaths/missing was at 207; flooding at 47 provinces; land damages to 3.4 million rai;, and several areas were flooded over three months affecting 4.2 million people.

Major floods in Thailand occur frequently at the Chao Phraya River basin. Its catchment area is about 159,000 km^2, equivalent to 35% of the country's total land area. The population in the basin is about 24 million. According to an interview survey by the JICA Study Team in Thailand, while the flow capacity of the Nakorn Sawan River in the upper basin is 4000 m^3/s, it decreases to 1500 m^3/s in Ayutthaya in the central basin and then becomes 3000 m^3/s in the Bangkok area in the lower basin. The natural set-up of the flow capacity of the Chao Phraya River is also one of the causes for the basin to be a flood prone area. As such, 35,000 km^2 of area, or 22% of the basin, was considered a flood risk area according to local presentation documents.

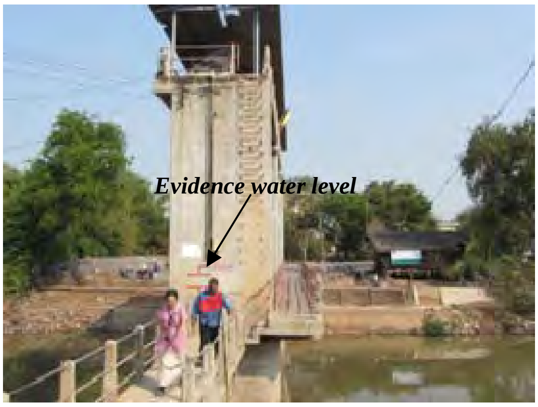
Source: DWR

Figure 6.1.4 Flood map

Major past floods in the basin occurred in 1975, 1978, 1980, 1983, 1995, 1996, 2002, and 2006. Among them, the flood events that brought about large-scale damages are described in Table 6.1.4.

2) Overview of Floods in 2011

Large-scale flood, which caused severe damage to lives and properties in the Chao Phraya River basin, started in June 2011 in the northern regions by Tropical Storm Haima bringing 128% of the average rainfall in the region. In July and August, Tropical Storm Nock-Ten hit the region again which resulted in rainfall of more than 150% of the average for both months of June and July 2012 (according to Thailand Flooding 2554 Rapid Assessment for Resilient Recovery and Reconstruction Planning, World Bank, 2012). The storms continued to hit the country and rainfall remained above average throughout September and October 2011. Continuous large-scale precipitation caused enormous discharge at the upper part of the Chao Phraya River basin. According to data collected by local authority, the recorded peak discharge at an observation point at Nakhonsawan Province on October 13, 2011 was 4686 m^3/s, which almost reached the historical peak flood of 4820 m^3/s in the 1995 event. Accordingly, flooding extensively occurred in areas of the central region.



Source: JICA Study Team

Figure 6.1.5 Evidence of Water Level (Site Reconnaissance in Ayutthaya)

During the period from September 14 to October 3, 2011, ten major flood control systems have overflowed or breached according to documents from the local authority). The water drained slowly from the northern to the central parts of the Chao Phraya River basin, eventually reaching Bangkok in early of November 2011. When large parts of Bangkok were flooded in mid-November, the affected population came to a peak of over 5 million.

The damages are described as follows:

- Flooded provinces: 71 of the country's 77 provinces (727 districts, 5,127 sub-districts, and 44,963 villages)
- Affected people: 13,737,871 (4,193,004 families)
- Estimated total affected land: 39,980 km^2 (18,000 km^2 of farmland, 380 km^2 of fish/shrimp ponds, 21,600 km^2 of livestock farms)
- Dead/missing people: 624

Source: Department of Water Resources (DWR)

The total damages and losses were estimated at approximately THB 1.43 trillion (USD 46.5 billion) (see Table 6.1.5). Based on the results, the real GDP growth in 2011 fell down to 2.9% from pre-flood real GDP growth projection of 4.0%. The impact on life and the cost of damages were estimated at more than 100 times of the cost of damages in 1983.

According to results of the interview survey conducted by the JICA Study Team in Thailand, this flood also caused severe damages to Japanese enterprises in Thailand comprising of seven flooded industrial complexes, one partly inundated complex, and five complexes under alert levels.

Table 6.1.5 Damages and Losses by Sector

Unit: million Thai Bath

Sub sector	Needs			Needs			
	Public	Private	Total	6 mnth	6-24 mths	>24 mths	Total
Infrastructure							
Water Resources Management	54,075	15,000	**69,075**	3,023	15,462	50,590	**69,075**
Transport	23,538	-	**23,538**	6,866	14,376	2,296	**23,538**
Telecommunication	2,026	2,052	**4,078**	1,675	1,422	980	**4,078**[a]
Electricity	5,624	-	**5,624**	899	3,036	1,689	**5,624**
Water Supply and Sanitation	5,633	-	**5,633**	2,997	2,635		**5,633**[a]
Productive							**0**
Agriculture Livestock and fishery	4,570	-	**4,570**	3,425	1,125	20	**4,570**
Manufacturing		209,005	**209,005**	30,832	164,502	13,671	**209,005**
Tourism	3,280	2,186	**5,466**	4,343	1,123		**5,466**
Financing & Banking	234,520	176,919	**411,439**	170,140	187,907	53,392	**411,439**
School							
Health	2,318	-	**2,318**	1,128	870	319	**2,318**[a]
Social	20,700	-	**20,700**	13,300	7,400		**20,700**
Education	13,343	-	**13,343**	8,045	5,298		**13,343**
Housing	5,128	-	**5,128**	3,657	1,471		**5,128**
Cultural Heritage	7,514	2,640	**10,154**	6,183	3,971		**10,153**[a]
Cross Cutting			**0**				**0**
Environment	6,181	2,004	**8,184**[a]	3,724	1,619	2,841	**8,184**
Total	**388,448**[a]	**409,806**	**798,254**[b]	**260,237**	**412,218**[a]	**125,798**	**798,253**[b]
Private Needs				133,600	211,624	64,582	**409,806**
Public needs				126,637	200,595	61,216	**388,448**
As % post-flood revenues				6.3	8.8	2.4	

Source: Thailand Flooding 2554 Rapid Assessment for Resilient Recovery and Reconstruction Planning, World Bank 2012

Note: Digits with a: as appeared in the source table, though the last digits are not consistent with calculation.
Digits with b: as appeared in the source table, though those two should be equal.
1 US$= 31.51 THB as of August 2012

(2) Risk Assessment

1) Current Situation

A flood vulnerable area has been established based on past flood records and studies. For the Chao Phraya River basin, 35,000 km^2 or 22% of the basin, was designated as flood vulnerable areas. Inundation maps of past floods were made but with no accumulative data on inundation depths. Numerical simulation models were built for flood forecasting such as weather forecasting model (Regional Spectral Model, RSM), flood model for the Chao Phraya River basin, hydrologic circle model (MIKE 11), etc.

The Committee for Monitoring and Analyze Water Situation was established for flood forecasting with members from the Royal Irrigation Department (RID), Thai Meteorological Department (TMD), Bangkok Metropolitan Administration (BMA), Department of Water Resources (DWR), Electricity Generation Authority of Thailand (EGAT), Hydro and Agro Informatics Institute (HAII), Department of Disaster Prevention and Mitigation (DDPM) and Navy Department.

The JICA cooperative projects on water control and flood problems are as follows:

- 1985: Master Plan for Flood Drainage System of Bangkok
- 1988: Study for the Chao Phraya River Flood Warning System
- 2000: Study for Flood Control Plan at the Chao Phraya River Basin

2) Issues and Needs

In 2008, the DWR started to prepare flood risk maps for medium- and long-term flood relief plans based on existing graphical images of various departments. For future flood risk assessment, survey and data collection for inundation depths in the flood events are also necessary. Research and development of flood risk assessment should continuously be conducted[29].

(3) Monitoring / Early Warning System

1) Current Situation

Meteorological observations are being carried out by the TMD, RID, and DWR.

The TMD is the key agency for providing weather forecast information to the entire country. It undertakes meteorological observation, upper weather observation, satellite imagery observation, and metrological radar observation. The agency releases in the website daily weather report observed at the 122 stations. It plans to update the existing monitoring system in a five-year plan, but the plan had been delayed due to budgetary constraints.

The RID operates 536 metrology and hydrology stations along major rivers but most of the equipment and facilities are decrepit.

The DWR has 120 telemetry stations for metrology and hydrology observation, and operates CCTV for river monitoring system and observation stations for EWS.

The BMA has also been operating metrological and hydrological observations in the Flood Control Center (FCC). The equipment includes one unit of C Band Radar, 127 rain gauge stations, and 113 units of water level sensors in the main canal.

As for early warning, the TMD is the key agency. The agency conducts data analysis regarding thunderstorms, heavy rains, floods, tropical cyclones, etc., based on information from weather maps, satellite imagery, radar observation, synoptic chats, upper air observation, etc. Thereafter when necessary, the TMD issues alert warnings upon the results of data analysis. The alert information will be provided to central government agencies, local government

[29] The view is attributed to the JICA Study Team.

agencies, regional meteorological centers, and mass media. At present, local government agencies issue the alert warning to areas under their jurisdiction. The TMD is now preparing their systems to directly issue alert warnings to subject areas.

The DWR operates EWS at 2,400 villages at present, but it also plans to expand the system to 6,000 villages.

2) Issues and Needs

Meteorological and hydrological observations are now being carried out by several agencies such as the RID, TMD, and DWR utilizing various data acquisition methods. Though such agencies hold a meeting per week for coordination as a collaborative policy, data unification is a central issue among parties concerned. The TMD (NDWC) proposes data centralization for EWS, but it has poorly progressed at present, possibly due to insufficient budget[30].

The other issues[31] noted are as follows:

a) To increase the coverage of early warning stations for typhoon/cyclone and flush flood,
2. To maintain dissemination systems due to variety of several types,
3. To increase reliability of the weather forecasting by enhancing forecasting technology, and
4. To formulate guidelines for warning procedures for each agency and to standardize such guidelines among the agencies concerned.

With the issues above, potential needs will be as follows:[32]

1. To update the monitoring system of the TMD and observation equipment of the RID,
2. To install EWSs at the provincial level,
3. To promote public awareness, education, and advocacy,
4. To conduct evacuation drills at the provincial level, and
5. To conduct disaster prevention training at the community level.

(4) Preparedness / Prevention and Mitigation

1) Current Situation

The key agency for flood risk mitigation in the country is the RID of the Ministry of Agriculture. The mitigation measures in the country are as follows:

- Structural Measures: dams, pumps, polder embankments, dykes, channel improvements, drainage (inner pump/sub-channel/drain pipe), and flood walls
- Non-Structural Measures: retention basin, land use control, public information and education, reservoir operation, flood forecasting and warning, and flood fighting.

The key agency for flood mitigation in Bangkok Metropolitan Area (BMA) is the Bangkok Metropolitan Administration. According to presentation documents of the Bangkok

[30] The view is identified by TMD (NDWC) in the interview with the JICA Study Team.
[31] The view is attributed to the JICA Study Team.
[32] The view is attributed to the JICA Study Team.

Metropolitan Administration, as for flood mitigation works in BMA, dikes along the Chao Phraya River, Bangkok Noi Canal, and Maha Sawat Canal were constructed totaling to 75.8 km of length with an additional 1.2 km long which is under construction. Also operated by the Bangkok Metropolitan Administration are 211 main drainage canals (920 km long), 1,444 minor drainage canals (1,686 km long), 369 pumping stations, and gates with a total pumping rate of 1,531 m^3/s. The drainage capacity of those pumping systems is 60 mm/hr of rainfall intensity.

Drainage tunnels are also being constructed in areas in BMA where the surface drainage system is insufficient. The tunnels constructed 15-22 m below the ground surface were designed to drain exceeding storm/flood water and be pumped out to the river by high capacity pumps. Now, there are seven drainage tunnels with a total length of 19 km and drainage capacity of 155 m^3/s. Also, the Bangkok Metropolitan Administration has provided 21 detention ponds with a total capacity of 12.7×10^6 m^3 to temporarily store early rainfall water in order to decrease peak runoff during rainfall.

Future plans for flood mitigation that are under consideration are as follows:

- Construction of ring levees and/or repairing of dike,
- Revision of the master plan,
- Construction of large dams,
- Allocation of flood way by using farm lands,
- Arrangement of retarding basins,
- Construction of diversion channels,
- Construction of embracement levee on riverbanks near economic areas/cities,
- Cleaning of drain pipes/canals, particularly in urban areas,
- Formulating a land use plan, and
- Dredging of the main rivers.

2) Issues and Needs

The issues and needs identified are as follows:

- Establishment of water laws and river laws,[33]
- Introduction of a single command system for water management,[34]
- Formulation of risk management of large-scale and extensive floods, including systematic countermeasures before, during, and after flooding [35]
- Integrated flood control and drainage plan for Bangkok, SEZ and supply chain, and[36]
- Promotion of flood control for the public understands[37].

[33] The view is identified by DWR in the interview with the JICA Study Team.
[34] The view is identified by DWR and DDPM in the interview with the JICA Study Team.
[35] The view is identified by DWR in the interview with the JICA Study Team.
[36] The view is identified by DWR in the interview with the JICA Study Team
[37] The view is identified by DWR in the interview with the JICA Study Team.

(5) Emergency Response

1) Current Situation

In response to the floods of 2011, the Flood Relief and Operation Command Center was newly established to provide rapid emergency response and coordination among responsible government bodies.

According to the World Bank Report (Thailand Flooding 2554 Rapid Assessment for Resilient Recovery and Reconstruction Planning, 2012), the Ministry of Social Development and Human Security provided more than 2,400 shelters nationwide while the Bangkok Metropolitan Administration provided 175 shelters for residents of the capital city. The Ministry of Public Health set up emergency clinics near shelters but also in flood affected areas throughout the country.

The Thai Red Cross provided and delivered food and non-food needs, such as relief kits, bottled water, food packs, ready-to-eat meals, and medical kits, in critically affected areas. The Royal Thai Army sent 56,000 of its members for water management, care, and assistance to people in need, management of relief supplies, and support to other agencies and sectors. The military also worked on monitoring flood defenses, water flow acceleration, and waterway evacuation missions.

2) Issues and Needs

The issues identified are as follows:[38]

- Panic and conflict among people,
- No consistent and unified decisions/commands from authorities,
- Insufficient information given to the public, and
- No smooth coordination between the public and private sectors resulting in mismatching assistance to the suffered.

All those above are considered to be lack of preparedness for emergency situations. Therefore, a disaster management plan including SOP and EOP (: Emergency Operating Procedures) at all the levels needs to be formulated and established.

Furthermore to the formulation/establishment of such a disaster management plan, the efforts needed are as follows:[39]

- Regular exercises and drills of SOP and EOP at all levels of all agencies concerned;
- Including, regular exercises and drills of evacuation at all levels; and
- Regular promotion of public awareness, education, and advocacy.

[38] The view is identified by DWR in the interview with the JICA Study Team.
[39] The view is attributed to the JICA Study Team.

6.1.10 Vietnam

(1) Present Situation of Flood Disaster

Flood disaster has been recognized as the most frequent disaster in Vietnam. Due to the frequency of flood issues in northern Vietnam in recent years, urban drainage issues caused by urban development are being focused on. In the central part of the country, floods occur every year. Even in the recent five years, residential and commercial areas of Hoi An and Hue cities have suffered from a few severe floods with inundation depths that exceeded 2.0 m in height. In addition, in Can Tho City located at Mekong Delta in the southern region of the country, serious and wide ranging floods often occur due to combined heavy rainfall and storm surges. Although a few deaths have been reported, flooding has affected agricultural crops and the lifestyle of people.

(2) Risk Assessment

Flood hazard maps for the Mekong River basin has been developed by the MRC based on the actual inundation areas during the floods in 1995, 1996, and 2000. Also, flood hazard maps for four provinces including Thua Thien Hue Province were prepared through the Natural Disaster Risk Management Project in 2010.

(3) Monitoring / Early Warning System

Hydro-meteorological monitoring and flood forecasting are conducted by the National Hydro-Meteorological Service (NHMS). There are 70 hydrological monitoring stations all over the country. Five-day advance flood forecasting is made every six hours. The results of the forecasts are shown in their website including flood warning information, which is categorized into three steps.

(4) Preparedness / Prevention and Mitigation

River dikes designed for 100-year floods have been constructed along the Red River in Hanoi. They are maintained by the Department of Dyke Management, Flood and Storm Control (DDMFSC) by using a systematic database.

Urban drainage issues caused by urban development are being focused on. In order to solve such issues, Phase 2 of the drainage project in Hanoi is being started.

A committee chaired by the DDMFSC controls the release of discharge during flood season in four out of the seven large dams in the country, namely Hoa Binh, Tuyen Quang, Son La, and Thac Ba. Floods that were assumed to be caused by incorrect reservoir operation were reported in the past, and DDMFSC recognizes the possibility of similar accidents in the future.

(5) Emergency Response

At the time of Typhoon Ketsana in September 2009, there was significant difference in damage situations at each commune depending on their respective response activities. In some communes such as Binh Duong Commune in Quang Ngai Province, flood damages were quite limited since their disaster response plan had been formulated in advance and had been well known to residents in workshops and meetings on a regular basis.

In Huong Tho Commune in Thua Thien Hue Province, a pilot project for community-based disaster management had been carried out. A committee at commune level has been established. After its organization, it started activities in 2010 for the development of information dissemination method and hazard maps.

(6) Issues and Needs

- It is recognized by the NHMS the need to increase the number of monitoring stations for both rainfall and river water level. Improvement of monitoring accuracy and the data transmission system is also one of the issues[40].
- Although river dikes designed for 100-year floods have been constructed along the Red River in Hanoi, the problem is that a great number of families have settled along the river lands a very long time ago[41].
- With respect to dam operation, it is necessary to review dam operation rules, to reallocate flood control capacity, and to introduce a legal system for reservoir operation rules[41].
- There are two existing and one ongoing large dams under the management of the Hue Office of the Department of Agriculture and Rural Development (DARD). At present, each dam has its own operation rules, and it was supposed to have difficulty in coordination of operations among the dams during floods[42].
- The urban area of Hanoi is expanding to the west, however, drainage measures have not been implemented. In this regard, it is required to implement urban drainage projects intended in unadministered areas of large cities such as Hanoi and Ho Chi Minh[41].
- It is desirable to duplicate the community-based disaster management system of other areas based on the experiences of the pilot project in Huong Tho Commune[41].

6.2 Earthquake and Tsunami

6.2.1 Brunei

(1) Present Situation of Earthquake and Tsunami Disaster

Earthquake disasters are not common in Brunei; however, tsunami disasters may occur due to strong earthquakes considered to have occurred outside the country. For example, a strong earthquake that may occur in the Manila Trench could cause adverse impacts in coastal areas of Brunei where oil and gas production and processing facilities are located. Also, local fishing villages along the coast will be affected.

The meteorological agency of Brunei is monitoring and getting international tsunami information through its existing networks.

Tsunami simulation analysis is needed to assess vulnerability along the coastal areas and oil production facilities in Brunei. Based on the simulation analysis, a tsunami disaster management plan should be formulated for use in disaster mitigation.

[40] The view is identified by NHMS in the interview with the JICA Study Team.
[41] The view is attributed to the JICA Study Team.
[42] The view is identified by Hue DARD in the interview with the JICA Study Team.

(2) Monitoring / Early Warning System

Construction of a tsunami warning system and implementation of community-based tsunami evacuation drills will be necessary to reduce the damage caused by a tsunami. In the construction of a tsunami early warning system, international exchange of information among neighboring countries is very important to implement emergency responses should a tsunami occur.

(3) Issues and Needs

1) Issues

a) Not specifically identified.

2) Needs[43]

a) Formulation of a tsunami disaster management plan including disaster risk assessment, and proposal of tsunami monitoring and early warning systems.
b) Regional collaborative research on the mechanism and characteristics of earthquakes and tsunamis induced by the Manila Trench.

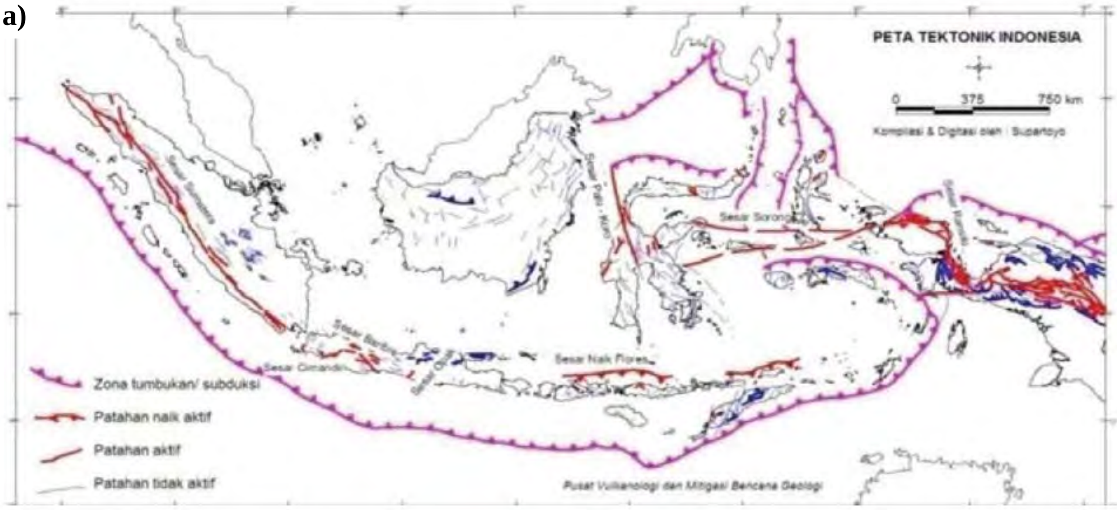
6.2.2 Indonesia

(1) Present Situation of Earthquake and Tsunami Disaster

Indonesia is located on an earthquake belt along the boundary of tectonic plates, and has many active faults (Figure 6.2.1a). Earthquakes with a magnitude of greater than 5.5 have occurred at an average of about 100 times per year. From 1991 to 2009, a total of 30 destructive earthquakes and 14 destructive tsunamis have been recorded (Figure 6.2.1b). In particular, many large earthquakes have occurred at the Java and Sumatran trenches wherein the Indo-Australian Plate is subducting beneath the Eurasian Plate.

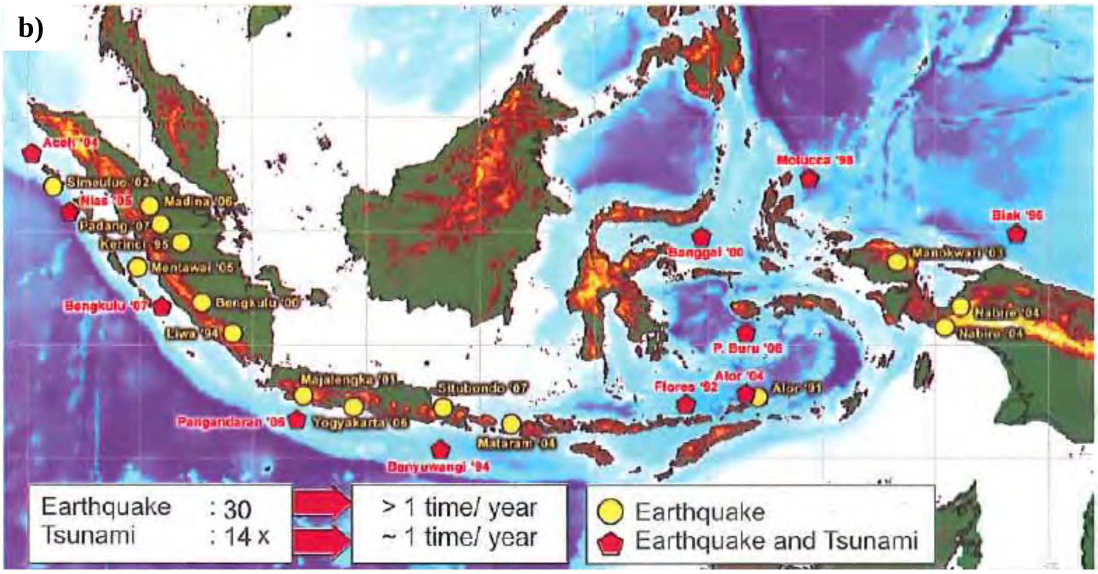
[43] All the views are attributed to the JICA Study Team.

a)



Source: BNPB, National Disaster Management Plan 2010-2014, pp.7, Figure 2.1

b)



Source: BMKG, InaTEWS Concept and Implementation, pp.4, Figure 9

Figure 6.2.1 a) Map of Tectonic Plates and Distribution of Active Faults in Indonesia, b) Destructive Earthquakes and Tsunamis in 1991-2009

Earthquakes greater than M_w=8 have occurred in the past, particularly in Bengkulu and West Sumatra in 1833 (M_w=8.3), Mangole and Taliabu in 1998 (M_w=8.3), Maluku in 2004 (M_w=9.0), Northern Sumatra in 2004 (M_w=9.1), Aceh and North Sumatra in 2005 (M_w=8.7), Nias Island and Bengkulu in 2007 (M_w=8.4), and Northern Sumatra in 2012 (M_w=8.6). In particular, the earthquake in the Indian Ocean off Sumatra was followed by a large-scale tsunami that hit Aceh on December 26, 2004 (M_w=9.1) killing over 170,000 people and leaving 120,000 missing people.

(2) Risk Assessment

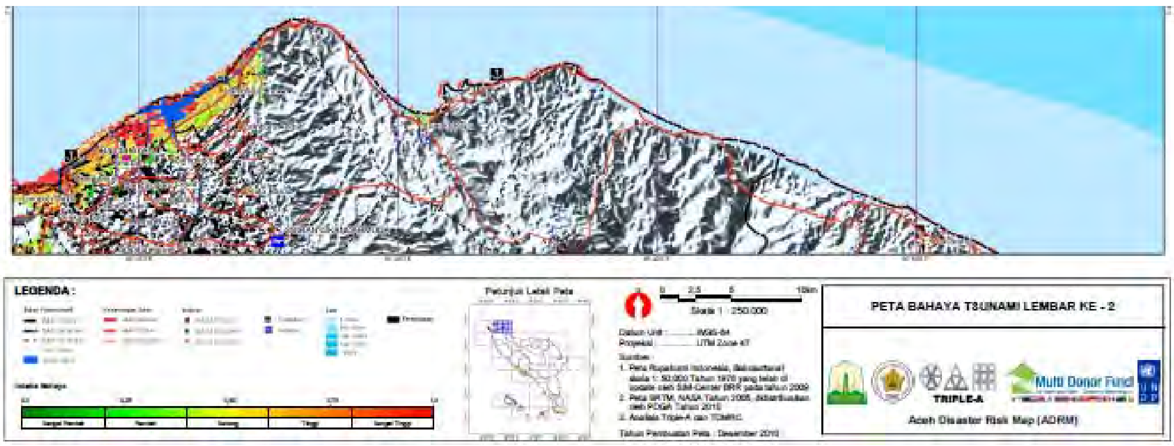
Several seismic hazard maps have been developed by relevant institutions. Multi-hazard maps for flooding and tsunami have been published and posted on the website by the Geospatial

Information Agency (BIG)[44] of Ministry of Energy and Mineral Resources. The active fault maps of Merapi volcano and Karkato volcano; and the seismotectonic map of Manado were developed by the Geology Research Development Centre (GRDC). In 2012, investigation on the Palu-Koro Fault in Celebes Island has been conducted using aerial photographs.

Tsunami hazard maps of Sulawesi, Barat, Grontalo, and Aceh have been developed by the GRDC. In 2012, developments of tsunami hazard maps of Sulawesi Utara and Sulawesi Selatan have commenced. For Aceh Province, risk maps have been developed by TDMRC (Tsunami & Disaster Mitigation Research Center, Syiah Kuala University) as shown in Table 6.2.1 and Figure 6.2.2.

Table 6.2.1 Risk Maps of Aceh Province

Name	Summary
ADRM (Aceh Disaster Risk Map)	Hazard map and vulnerability map of earthquakes, tsunamis, volcanoes, and landslides in Aceh Province.
ATaDRM (Aceh Tamiang Disaster Risk Map)	Hazard map and risk map of earthquakes and landslides in Aceh Tamiang District.
ABaDRM (Aceh Barat Disaster Risk Map)	Hazard map and risk map of earthquakes, landslides, and tsunamis in Aceh Barat District.



Source: Ache Disaster Risk Map, 2011

Figure 6.2.2 Example of Aceh Disaster Risk Map (ADRM)

A database on disasters in Indonesia called DIBI (Data dan Informasi Bencana Indonesia) has been published on the website of BNPB[45].

Since the maps have been drawn by various government offices, the JICA Study Team recommends that the portal site for hazard maps and risk maps needs to be developed in order for users to collect information easily.

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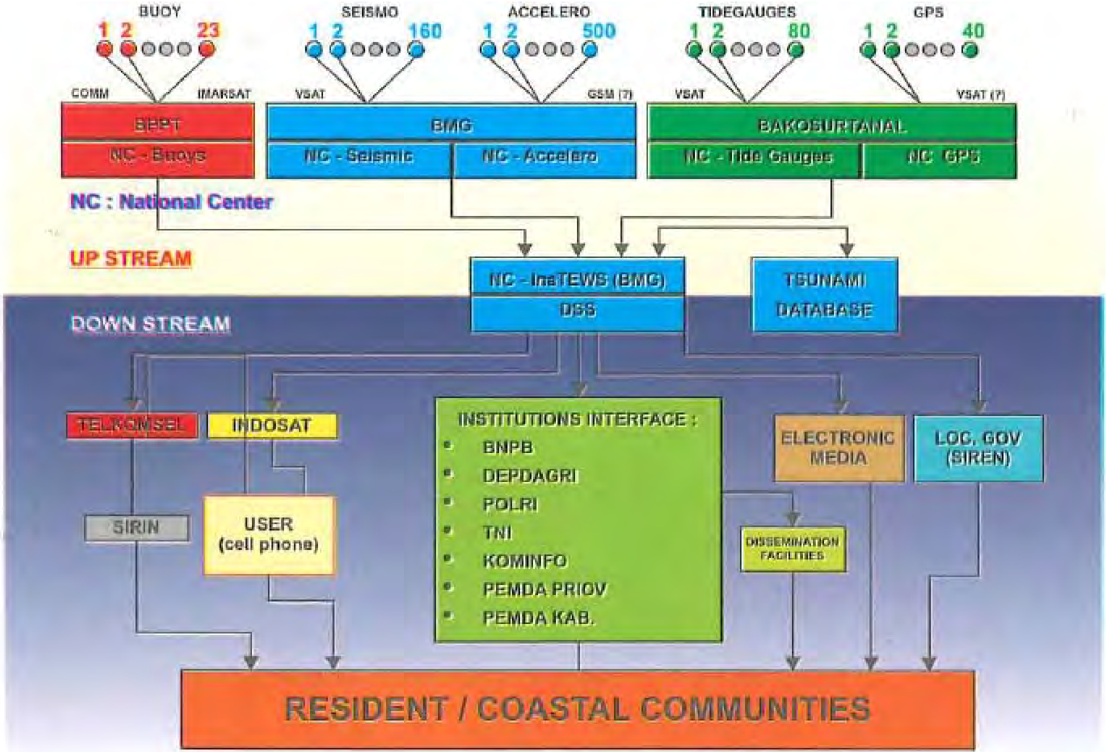
44 BIG website: http://www.bakosurtanal.go.id/bakosurtanal/multihazard/sumatera.html

45 http://dibi.bnpb.go.id

(3) Monitoring / Early Warning System

Shake maps, which indicate the modified Mercalli intensity of each earthquake event, are produced by the BMKG using USGS software after the occurrence of an earthquake. Such maps have been transmitted to BNPB and published on the BMKG website (http://inatews.bmkg.go.id).

The early warning system for tsunami called InaTEWS (Indonesia Tsunami Early Warning System) has been introduced to Indonesia through the support from Germany and it has been operated by the BMKG. InaTEWS is an integrated system composed of seismic and tsunami observations, analysis, judgment, and dissemination (see Figure 6.2.3).



Source: BMKG, InaTEWS Concept and Implementation, pp.11, Figure 14

Figure 6.2.3 Basic Concept of InaTEWS

Seismic observation has been conducted using the instruments listed in Table 6.2.2. The observation data is transmitted through satellite VSAT system to the InaTEWS National Center operated by BMKG. According to the BMKG, the number of observation instruments have been planned to be increased in order to improve the observation accuracy for earthquakes and tsunamis and the speed of hypocenter and magnitude determinations.

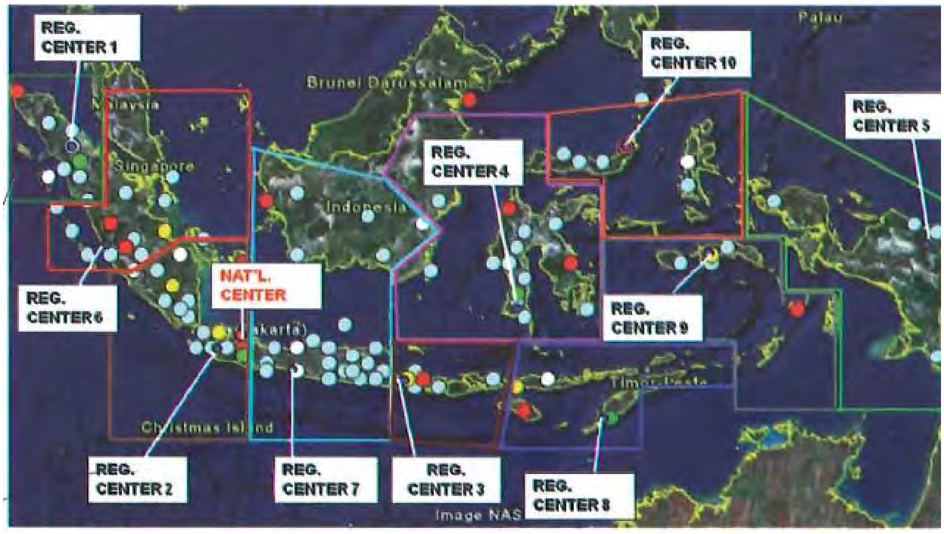
Since observation instruments are manufactured in foreign countries making them expensive for the nation, many Indonesian researchers wish to develop/manufacture such observation instruments in Indonesia. The BMKG says that technology and knowledge need to be introduced in order to be able to manufacture the additional observation instruments in the country.

Table 6.2.2 List of Observation Instruments for InaTEWS

Name	Planned Quantity**	Present Quantity*	Failure**	Responsibility*
Broadband Seismometer	160	160	About 20%	BMKG
Accelerometer	500	216	About 20%	BMKG
GPS	40	20	-	BIG
Buoy	23	2	-	BPPT
Tide Gauge	80	58	Low	BIG

Source: *BMKG, *InaTEWS Concept and Implementation*, pp.412-15, ** Interview with BMKG, on February 8, 2011

The software "SeisComp3" in InaTEWS has been utilized to analyze the hypocenter, magnitude and occurrence time of an earthquake.



Source: BMKG, InaTEWS Concept and Implementation, pp.12, Figure 16

Figure 6.2.4 Broadband Seismograph and Accelerograph Network

The information system of InaTEWS disseminate the warnings to the BNPB, Ministry of Communication and Information Technology (KOMINFO), BPBD, police, army, local governments, TV station, etc. by digital video broadcasting (DVB) through satellite connection, telephone, fax, SMS, and internet. Regular television programs are interrupted to broadcast early warnings.

In Indonesia, several ways of transmitting disaster information have been established. The JICA Study Team recommends that a study on information methods needs to be conducted, considering the possibility that electricity and information networks would not be available due to an earthquake.

The building of the InaTEWS National Center, wherein InaTEWS is being operated, was built based on the seismic design code in Jakarta and is equipped with emergency electricity sources such as uninterruptible power supply (UPS) (for 30 minutes) and diesel generator (for six hours) in case a blackout occurs due to an earthquake.

The tsunami buoys are being operated by the BPPT at only two stations (whereas 23 stations are planned) because some of the buoys had either been stolen or vandalized. The BPPT has planned to install a new tsunami early warning system using submarine cable. The first one will be installed in June 2012. The BPPT conducts tsunami forecasting and issues a warning within 20 minutes after an earthquake occurs, based on tsunami monitoring results and their own tsunami simulation results. However, these results were not been taken into account in InaTEWS. InaTEWS utilizes the results of tsunami simulation conducted by the BMKG.

The BMKG, which operates the InaTEWS system, plans to introduce two new tide gauge systems. The existing tide gauge system of BIG is not capable enough to be utilized for the tsunami early warning system due to transmission speed, as it was installed for tidal fluctuation observation.

A tsunami warning is issued by BMKG within five minutes after an earthquake using Decision Support System (DSS), which takes into account the following:

a) The magnitude is over 7.0.
b) The earthquake focal depth is less than 100km.
c) The epicenter is under the sea.

The chief officer on duty (COD) of the team operating InaTEWS presented information on the height and arrival time of a tsunami within ten minutes, which is supported by DSS with reference to the tsunami simulation database. The tsunami computer simulation has already been conducted for all seas around Indonesia; however, only the tsunami simulation results on the west side of Sumatra Island and Java Island had been registered to DSS. Therefore, in case that an earthquake occurs in other unregistered regions, the InaTEWS operators have to determine corresponding tsunami simulation results manually. After which InaTEWS releases visual information through CCTV and observation data. If the tsunami had not been observed by the observation system, the tsunami warning would be cancelled.

Since only tsunami simulation results from a limited number of cases have been registered in InaTEWS, it is necessary to register the results of BPPT's and University's simulation into InaTEWS for timely issuance of tsunami early warnings, and also to improve the accuracy of tsunami warning simulation results by comparing actual tsunami observation data with the tsunami simulation results.

In case of the tsunami caused by the Mentawai Earthquake in 2010 (M_w=7.7), the tsunami simulation was not consistent with the result of actual tsunami observation. Hence, a new tsunami simulation program has been installed in InaTEWS; however, a comparison between tsunami simulation results and observed data has not been made yet.

In Aceh Province, tsunami warnings have been disseminated through the following steps:

a) Badan Penanggulangan Bencana Aceh (BPBA) receives information on a tsunami warning from the BMKG.
b) The BPBA transfers the information to the governor for confirmation of the necessity of a tsunami warning to the public.
c) Should a governor decides to release a tsunami warning, the BPBA alarms four sirens and informs the tsunami warning to the Fire and Disaster Management Agency (BPBK) via telephone.

d) The BPBK then informs the tsunami warning to the army, police, etc. via telephone. The tsunami information is broadcasted at the mosques as well through audio speakers.

A detailed tsunami simulation has been conducted by the Tsunami and Disaster Mitigation Research Center of Syiah Kuala University (TDMRC) in Aceh Province. However, its results have not been applied to InaTEWS. Also, the notification of a tsunami warning to registrants via SMS was tested through a pilot project by Syiah Kuala University.

The Ministry of Research and Technology (RISTEK) has adjusted for the differences between the investigations conducted by the National Institute of Science (LIPI), BPPT, and BIG.

Led by UNESCO, the Indian Ocean Tsunami Warning and Mitigation System (IOTWS) were established in 2011 as a tsunami early warning system in countries along the Indian Ocean. Indonesia has provided seismic information to IOTWS as the Regional Tsunami Information Center (RTSP) and informed early warnings to the ASEAN Earthquake Information Center (AEIC).

(4) Preparedness / Prevention and Mitigation

The following guidelines were published and upgraded by RISTEK, and are utilized as national standards:

- Guideline Tsunami Evacuation Map,
- Guideline Tsunami Evacuation Sign Boards (includes examples of full-size sign boards),
- Guideline Tsunami Evacuation Building Development, and
- Guideline Tsunami Evacuation Drill Implementation for City and Regency (edited by RISTEK and published as national guidelines).

Educational materials on tsunami disaster prevention were published by LIPI (see Figure 6.2.5).

Source: LIPI, Selamat dari Terjangen Tsunami, Cara Menarik Mewaspadai Dan Mengantisipasi Bencana.

Figure 6.2.5 Educational Materials on Tsunamis

A database on the disasters that have occurred in Aceh Province called DIBA (Data dan Informasi Bencana Aceh) has been posted on the website[46]. A pilot project which supported the preparedness and education in schools was carried out by Syiah Kuala University. The Aceh Tsunami Museum was constructed to educate people on tsunamis, and also to be used as a tsunami evacuation building that could accommodate 6,000 people. Educational materials on tsunami disaster prevention were published by the TDMRC (Figure 6.2.6).

The residents of Aceh Province were confused or did know how to respond when the magnitude 8.0 earthquakes occurred on April 12, 2012, possibly because knowledge on emergency evacuation has not been imparted enough to the public even in Aceh Province. Since it may be difficult to build large-scale structural countermeasures immediately due to economic and technical constraints, the JICA Study Team recommended that intensive education and training/exercises on evacuation as well as preparation of evacuation routes need to be carried out.

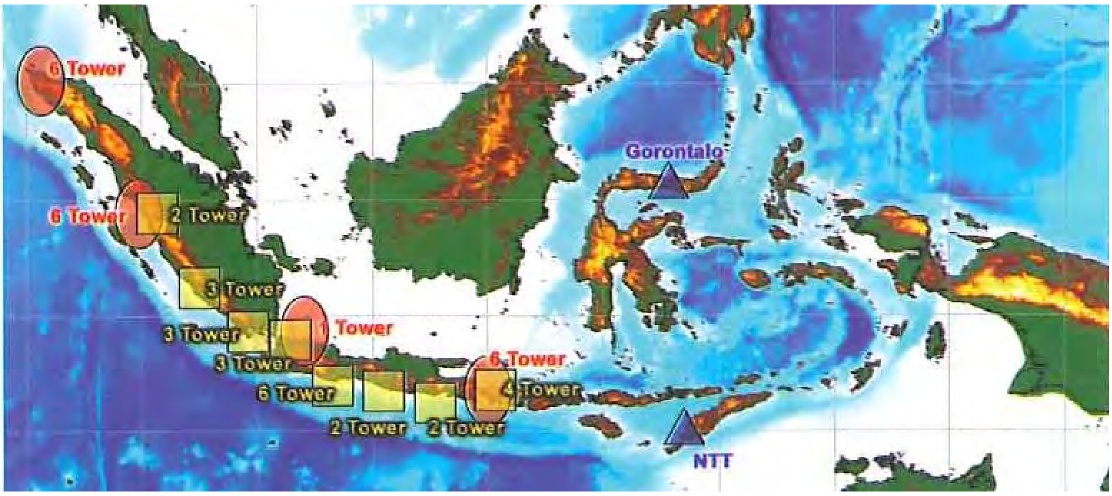
Source: a) TDMRC, *SMONG*, Vol.2, No.6, b) TDMRC, Kesiapsiagaan Bencana

Figure 6.2.6 Educational Materials on Tsunami

(5) Emergency Response

The warning system of InaTEWS is considered an effective method for dissemination of tsunami information. Twenty four units of the Tsunami siren have been installed in six provinces and are being operated by the BMKG in Jakarta (see Figures 6.2.7 and 6.2.8).

46 http://diva.acehprov.go.id



Source: BMKG, InaTEWS Concept and Implementation, pp.25, Figure 37

Figure 6.2.7 Tsunami Siren Network in Indonesia

Source: JICA Study Team

Figure 6.2.8 Tsunami Siren in Aceh Province

BPBA developed the SOP for tsunami disaster prevention including an evacuation plan and the contingency plans in all districts of Aceh Province.

There are four evacuation buildings in Aceh Province (Figure 6.2.9) constructed by a Japan's grant aid project; however, breakwaters and seawalls against tsunamis have not been constructed there.

According to Aceh province government, since local organizations sometimes are not familiar with the SOP, their officers need to master the SOP as part of their disaster management in case an emergency situation occurs. Therefore, further education and training are necessary.

Source: JICA Study Team

Figure 6.2.9 Evacuation Building at Aceh Province

（Four evacuation buildings were constructed by a Japan's grant aid project）

(6) Issues and Needs

1) Issues[47]

a) The BMKG plans to establish a monitoring network for InaTEWS strengthening that would consist of 160 broadband seismographs, 500 accelerometers, 40 GPSs, 80 tide gauges, and 23 buoys.

b) Since a large-scale earthquake could occur in the near future, an earthquake disaster management plan should be established. Jakarta is now being developed as an economic center of the ASEAN region, and a large-scale earthquake could greatly affect the city.

c) Research on seismology in the eastern part of Indonesia, particularly the regions facing the Cleves Sea where large earthquakes are considered to occur, has not been carried out. Detailed tsunami simulations have been conducted by various agencies in Indonesia, but the results have not been integrated into InaTEWS.

2) Needs[48]

a) Enhancement of the tsunami observation system for InaTEWS.

b) Formulation of a disaster management plan and BCP for Jakarta.

c) Research on seismology and tsunami in Celebes Sea.

6.2.3 Lao PDR

(1) Present Situation of Earthquake and Tsunami Disaster

Seismic activity in Lao PDR is limited in the northern part of Lao PDR and the main active faults are also distributed in the northern part. No earthquake has occurred in the main cities along the Mekong River basin. Earthquakes which have occurred in the northern part of Lao PDR had magnitudes of less than 6.0. There has been no significant damage due to earthquake in Lao PDR and its surrounding countries in the past. In recent years, a magnitude 5.5 earthquake occurred in Bokeo Prefecture, near the border of Thailand, in 1996 (Figure 6.2.10).

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[47] All views are identified by the BMKG, BPPT and relevant organizations on earthquake and tsunami disaster management in the interview with the JICA Study Team.

[48] All views are attributed to the JICA Study Team.

Houses and temples in Lao PDR as well as in Thailand were damaged and developed cracks due to the earthquake.

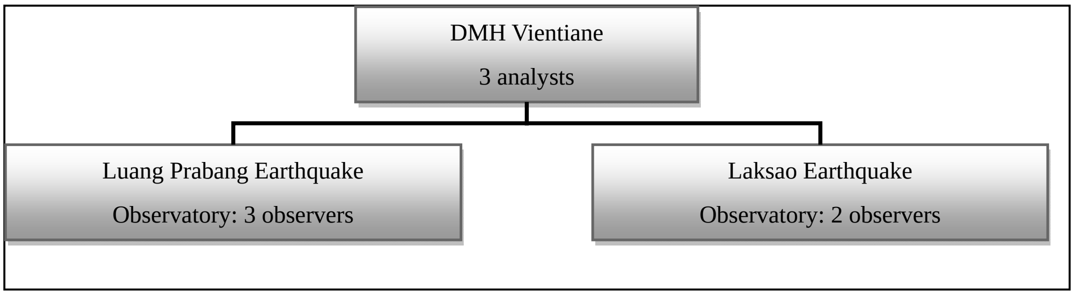
(2) Risk Assessment

According to the Strategic Plan of 2011 to 2015, the leading agency for the production of a hypocenter distribution map is the DMH; however, an earthquake hazard map has not been developed by any organization to date.

(3) Monitoring / Early Warning System

With assistance from the China Earthquake Administration (CEA), the DMH installed a broadband seismograph and a strong motion accelerograph at Luang Prabang and Laksao in 2008. Also, the DMH has conducted seismic observation since 2009. There were 34 earthquakes observed by the seismographs in 2009. The observation data was transferred to the CEA and DMH in Vientiane through VSAT satellite communication, and such data were archived in the DMH. The electric power of seismographs is supplied by AC power, and 12 batteries, such as the ones used for vehicles, were set as backup power supply. The seismographs have been working smoothly so far as they are checked occasionally and have been upgraded twice already. The observers in the local observatory cannot maintain the devices. In case of trouble, the DMH requests the CEA for repairs.

The seismic observation and analysis staff consist of three analysts in Vientiane, three observers in Luang Prabang, and two observers in Laksao (see Figure 6.2.10).



Source: Interview with DMH (Created by the JICA Study Team)

Figure 6.2.10 Seismic Observation System in DMH

The DMH presently conducts the determination of hypocenter and magnitude using software provided by the CEA. However, since there are only two observation stations in Lao PDR, in case an earthquake occurs, the DMH collects seismic information from surrounding countries such as China, Vietnam, and Thailand via internet; and thereafter they manually analyze the collected information. Therefore, hypocenter determination needs about an hour after the occurrence of an earthquake.

The DMH mentioned that increasing the number of seismographs is a most important issue, and also there is a need to develop the engineers' capacity for operations and maintenance of instruments, and analysis of data. The DMH also mentioned that with economic growth in the main cities such as Vientiane, analysis technique for strong motion observation data and design of quake resistance standards need to be developed.

In case that an earthquake occurs, the DMH at Vientiane analyzes the data from each observatory and then makes an official letter to the director general of DMH. Seismic information is transmitted from the DMH through the DMH branch office to the provincial disaster management committee whose chairman is the vice president. And also the DMH disseminates the information to the minister of MONRE, NDMC and mass media, and announces in their website as well. Communications with relevant authorities are conducted via fax. Mass media through TV and newspapers broadcast the earthquake information immediately depending on the scale of earthquake. Radio broadcasts such information more quickly.

(4) Issues and Needs

1) Issues[49]

a) Develop and improve the seismic monitoring system and to strengthen the capacity of monitoring and operation staff of the DMH are the most important issues.

2) Needs[50]

a) Development of a seismic observation network, and capacity development for the operation of the observation network.

6.2.4 Malaysia

(1) Present Situation of Earthquake and Tsunami Disaster

Earthquake disaster is not common in Malaysia; however the potential of a tsunami hitting Saba Sarawak has been considered. The Meteorological Agency of Malaysia is responsible for monitoring the occurrence of earthquakes and tsunamis in the country. For tsunami monitoring, modern equipment and a warning system have been installed in the Tsunami Monitoring Center at Kuala Lumpur. Recently, this center is focused on a possible tsunami disaster in Sarawak area should a strong earthquake occurs along the Philippine Island and the Celebes Sea.

At Sarawak, warning siren towers have been constructed and are managed by the Tsunami Monitoring Center.

(2) Risk Assessment

Tsunami risk assessment has not been fully conducted yet in tsunami expected areas. A possible earthquake and tsunami scenario should be assumed. Based on the scenario, tsunami simulation analysis including damage estimation is carried out. Also, the socioeconomic condition and infrastructure distribution in the possible tsunami area should be assessed for taking necessary mitigation measures or evacuation planning.

[49] All views are identified by the DMH in the interview with the JICA Study Team.
[50] All views are attributed to the JICA Study Team.

(3) Monitoring / Early Warning System

A seismograph network and tsunami monitoring and early warning system has already been established (MNTEWS). Seventeen broadband seismographs, 191 GPS, 3 buoys, 23 sirens and others have already installed. MMD has already possessed the simulation results of the possible tsunami to be generated in Manila Trench, though it is not practically exercised yet.

(4) Preparedness / Prevention and Mitigation

A tsunami disaster management plan needs to be compiled based on simulation analysis as already mentioned above. Along with this guideline, detailed tsunami disaster management activities will be conducted such as CBDRM, evacuation drills, checking of food and water supplies, operation of evacuation sites, and so on.

(5) Emergency Response

Enhancement of emergency response to tsunami disaster depends on community-based disaster management practice. In a potential tsunami disaster area or community, regular carrying out of drills and trainings for evacuation are recommended. Through drills and trainings together with school education, people's awareness on tsunami disaster would improve. For emergency response, modern equipment and an information system for early warning are also necessary; however, people's awareness on disaster management is the key issue.

(6) Issues and Needs

1) Issues[51]

a) Conduct risk assessment of tsunami disaster in Sarawak area, and strengthen the existing tsunami monitoring system.

2) Needs[52]

a) Formulation of a tsunami disaster management plan including disaster risk assessment, and proposal of enhancement tsunami monitoring and early warning systems.
b) Regional collaborative research on the mechanism and characteristics of earthquakes and tsunamis induced by the Manila Trench.

6.2.5 Myanmar

(1) Present Situation of Earthquake and Tsunami Disaster

In the Bengal Bay on the west part of Myanmar, there is the Andaman Trench wherein the Indian Plate is moving northward and subducting underneath the Burma Plate from west to east; in the east part of Myanmar, there is the Sagaing Fault which is the boundary of the Burma Plate and the Sunda Plate. Hence, 16 earthquakes with magnitudes of more than 7.0 have occurred, and six earthquakes of around 7.0 magnitudes have hit the main cities along the

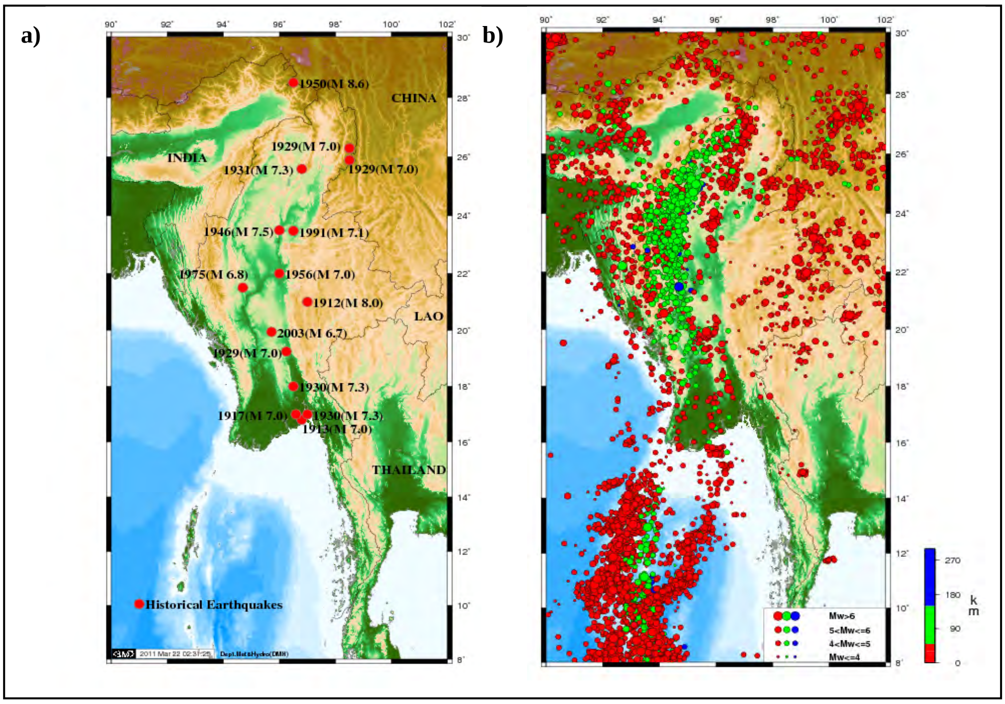
51 All views were identified by MMD in the interview with the JICA Study Team.
52 All views are attributed to the JICA Study Team.

Sagaing Fault such as Yangon, Bago and Mandalay from 1930 to 1956. Since the capital city Naypyidaw is located on the seismic gap along the Sagaing Fault, it was concerned that a large-scale earthquake may occur there in the near future.

The tsunami in 2004 caused by the earthquake in the Indian Ocean off the coast of Sumatra hit the delta area in southern Myanmar that killed about 64 people.[53]

In case that a large-scale earthquake occurs around the Andaman Trench, it is anticipated that a large tsunami would cause severe damages along the west coast of Myanmar.

Figure 6.2.11 shows the historical earthquake distribution map and the epicentre distribution map. Table 6.2.3 shows a list of main earthquake and tsunami disasters that occurred in Myanmar.



Source: DMH, Kelunji poster (PPT Slide a) 2, b) 1)

Figure 6.2.11 a) Historical Earthquake Distribution Map, b) Epicenter Distribution Map

Table 6.2.3 Main Earthquake/Tsunami Disasters in Myanmar

Date	Location	Comment	Mag.	Source
868	Bago	Shwemawdaw Pagoda fell		2
875	Bago	Shwemawdaw Pagoda fell		2
1429	Innwa	Fire-stopping enclosure walls fell		2
1467	Innwa	Pagodas, solid and hollow, and brick monasteries destroyed		2
1485/7/24	Sagaing	3 well-known pagodas fell		2
1501	Innwa	Pagodas, etc. fell		2
1564/9/13	Bago	Pagodas including Shwemawdaw and Mahazedi fell		2
1567	Bago	Kyaikko Pagoda fell		2
1582	Bago	Umbrella of Mahazedi Pagoda fell		2
1588/2/9	Bago	Pagodas, and other buildings fell		2
1591/3/30	Bago	The Great Incumbent Buddha destroyed		2

53 Hazard Profile of Myanmar July, 2009 Union of Myanmar, MES, MGS, Myanmar Information Management Unit (MIMU), ADPC

Date	Location	Comment	Mag.	Source
1620/6/23	Innwa	Ground surface broken, river fishes were killed after quake		2
1637/8/18	Innwa	River water flush		2
1696/9/15	Innwa	4 well-known pagodas destroyed		2
1714/8/8	Innwa	Pagodas, etc. fell; the water from the river gushed into the city		2
1757/6/4	Innwa	Shwemawdaw Pagoda damaged		2
1762/4/2	Sittwe	Very destructive violent earthquake felt over Bengal,Rakhine up to Calcutta.	7.0	2
1768/12/27	Bago	Ponnyayadana Pagoda fell		2
1776/6/9	Innwa	A well known pagoda fell		2
1839/3/21	Innwa	Old palace and many buildings demolished;		2
1839/3/23	Innwa	Pagodas and city walls fell; ground surface broken; the river flow was reversed for some time; Mingun Pagoda shattered; about 300 to 400 persons killed		2
1843/2/6	Kyaukpyu	Eruption of mud volcanoes at the Rambye (Ramree) Island		2
1848/1/3	Kyaukpyu	The civil line and other buildings were damaged		2
1858/8/24	Pyay	Collapsed houses and tops of pagodas in Pyay, Henzada, and Thayetmyo, and some damages in Innwa, Sittwe, Kyaukpyu and Yangon		2
1888/8/8	Bago	Mahazedi Pagoda collapsed		2
1913/3/6	Bago	Shwemawdaw Pagoda lost its finial		2
1917/7/5	Bago	Shwemawdaw Pagoda fell		2
1927/12/17	Yangon	Extended to Dedaye	7.0	2
1929/8/8	Near Taungoo	Bent railroad tracks, bridges and culverts collapsed, and loaded trucks overturned (Swa Earthquake)		2
1930/5/5	Near Khayan,Yangon and Bago Divisions	Collapsed houses and other buildings in Yangon and Bago Divisions. It killed approximately 500 people in Bago and 50 in Yangon.	7.3	1
1930/12/3	Nyaunglebin Township ,Bago Division	Railroad tracks twist (Pyu Earthquake); about 30 persons killed.	7.3	1
1931/1/27	East of Indawgyi	Imax=IX; numerous fissures and cracks (Myitkyina Earthquake)	7.6	2
1956/7/16	Sagaing	The Sagaing Earthquake caused large damage to ancient structures.	7.0	1
1976/7/8	Bagan,Mandalay Division	Several pagodas in Bagan Ancient City were severely damaged.	6.8	1
2003/9/22	Taungdwingyi Township, Magway Division	The earthquake destroyed or damaged many non-engineered brick structures and rural houses. About 180 rural houses and some primary school building were severely damaged.	6.8	1
2004/12/26	Irrawaddy	61 people were killed, 3 people were missing and 41 people were injured in the Irrawaddy Delta by the tsunami which crashed into shores around the Indian Ocean. 23 villages and 537 households were damaged and 2,592 people were affected.	-	2
2009/9/22	-	No casualties as a result of the earthquakes and aftershocks were reported in India.	5.6	1
2011/3/24	Near the Thai border	A magnitude 6.8 earthquake struck Myanmar near the Thai border on March 24. At least 25 people were killed and dozens of buildings destroyed.	6.8	1

Source: (1)Asian Disaster Reduction Centre (ADRC), GLobal IDEntifier Number (GLIDE) http://www.glidenumber.net/glide/public/search/search.jsp, (2) Hazard profile of Myanmar July, 2009 Union of Myanmar, Myanmar Engineering Society(MES),Myanmar Geosicences Society(MGS),Myanmar Information Management Unit(MIMU),Asian Disaster Preparedness Center (ADPC)

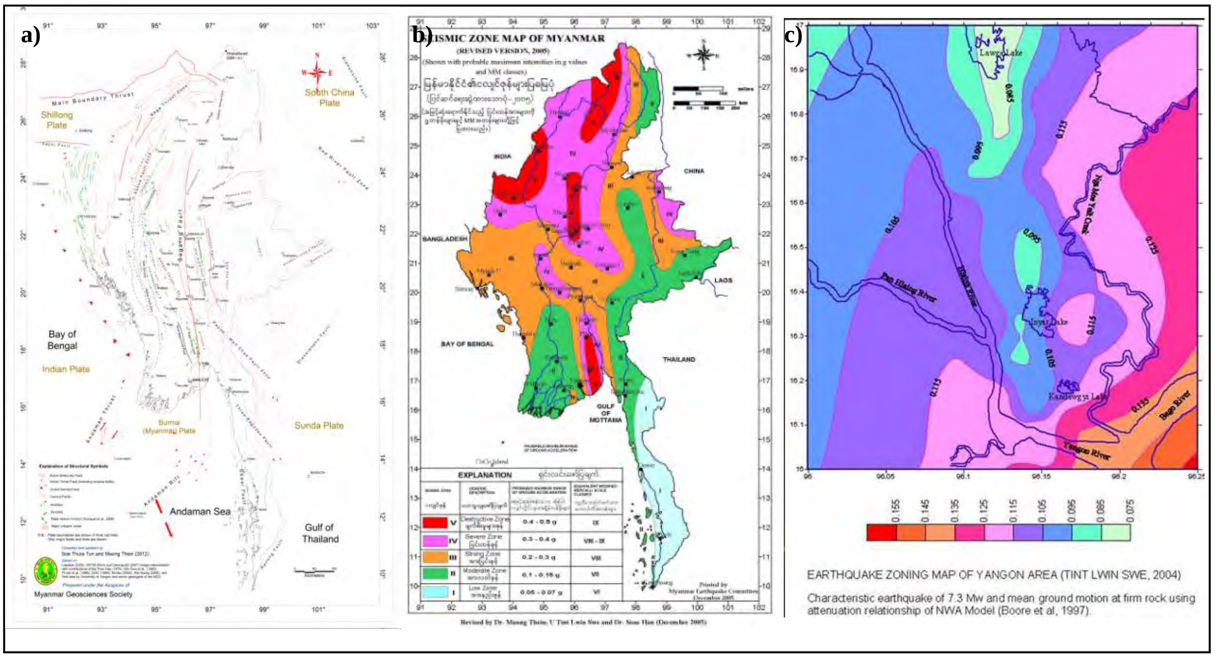
(2) Risk Assessment

A small-scale nationwide seismic zone map and a tectonic map of Myanmar were developed by the Myanmar Earthquake Committee (MEC) in 2004 and by the Myanmar Geosciences Society (MGS) in 2012, respectively (see Figure 6.2.12 a, b). According to MAPDRR, the DMH is in charge of creating earthquake hazard maps such as a seismic zonation map and make it available at community level; however, such hazard maps have not been started yet. On the other hand, the MEC developed seismic zonation maps of Mandalay-Amarapura, Bago-Oaktha, and Taunggyi until 2006 (see Figure 6.2.12 c). The earthquake hazard map of

Mandalay has been developed in collaboration with the Norwegian government. All other cities have planned to develop their hazard maps.

In order to formulate an earthquake disaster management plan for all main cities, the development of more detailed topographical maps and improvement of accuracy of hazard maps are needed. Since Myanmar has experienced many large earthquakes and tsunamis in the past, the JICA Study Team recommends that there is a great need for risk assessment of earthquake disaster including hazard mapping.

Tokyo University and Kyoto University in Japan have researched about seismic activity history in collaboration with the MES and conducted a trench survey along the Sagaing Fault.



Source: a) Tint Lwin Swe (2004), b) Soe Thura Tun and Maung Thein, MGS (2012), c) MES (2005)

Figure 6.2.12 a) Tectonic Map, b) Seismic Zone Map, c) Earthquake Zoning Map

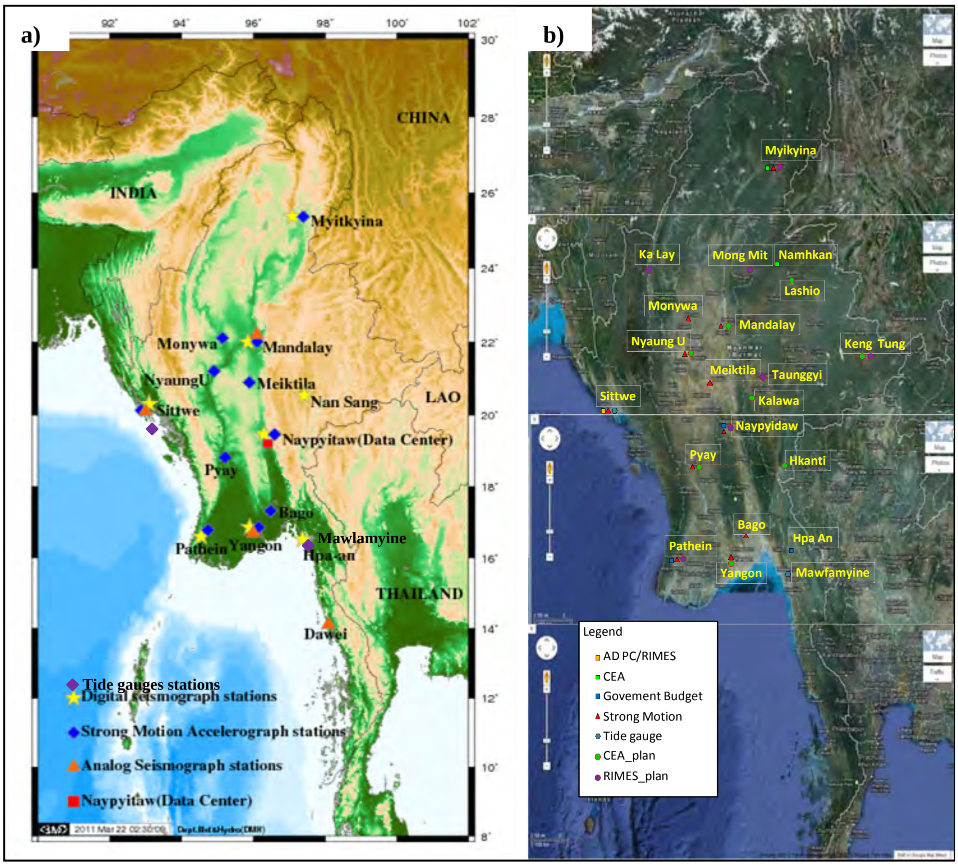
Other concerned organizations have not yet developed any tsunami hazard map. On the other hand, the evacuation routes have been planned and tsunami evacuation drills have been conducted using such routes. Preparedness for tsunami disaster prevention has been cooperatively addressed by the national and local governments.

The DMH wants to increase the number of seismic observation points. The JICA Study Team recommended to conduct tsunami simulation based on observation data and to study the results of earthquake faults in order to identify the areas that may be affected by a tsunami, especially the Bay of Bengal. Also there is a need to conduct capacity building of DMH staff for their operation and evaluation of simulation and analysis.

(3) Monitoring / Early Warning System

Eight broadband seismographs have been installed by the Myanmar government, CEA, Yunnan Seismic Bureau (YSB), and Regional Integrated Multi-Hazard Early Warning System

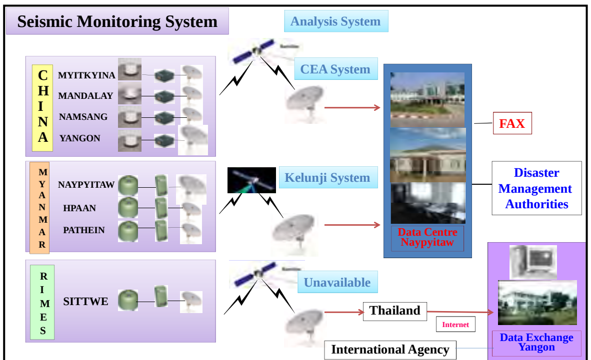
(RIMES) (see Figure 6.2.13 a). However, the seismographs installed by the CEA and YSB have not been working as of February 2012 due to breakdown of battery. The seismic observation data conducted by RIMES has not been received in Myanmar. Therefore, only two digital broadband seismographs (manufactured by Kelunji) installed using DMH budget, and three analog seismographs installed by JICA from 1962 to 1985 have been utilized for seismic observation. The number of seismographs is not sufficient at all, and therefore needs to be increased. The DMH also strongly hopes to strengthen the capacity of seismic observation staff.



Source: a) DMH, *Kelunji poster* (PPT Slide 1); (modified by the JICA Study Team), b) the JICA Study Team

Figure 6.2.13 a) Seismograph Location Map, b) Proposed Seismograph Location Map

The CEA and RIMES have planned to increase seismographs (see Figure 6.2.13 b); some of the proposed stations are duplicated. Seismic observation data of seismographs installed by foreign organizations and by the Myanmar government are transmitted and analyzed separately (Figure 6.2.14).



Source: DMH, *Kelunji poster* (PPT Slide 4; modified by the JICA Study Team)

Figure 6.2.14 Seismic Observation System

At present, the DMH has only 13 staff for seismic observation and analysis.

According to the DMH, not only the increase of the number of staff and the upgrading of seismographs are a big issue, but also the development for human resources for proper operation and analysis.

The software manufactured by Kelunji adopted by the DMH is available for hypocenter and magnitude determination. However, the DMH has difficulty using the software because internet communication speed is very low. Accordingly, the DMH determines hypocenters annually by adding the results of analog seismographs. Therefore, hypocenter determination takes about 45 minutes to an hour after a quake. In addition, the accuracy is very low because of the limited number of observation stations.

Observation data from seismographs of the CEA must be analyzed for hypocenter determination by using software installed by the CEA. Hence, the DMH must use two earthquake observation systems, that of Kelunji and the CEA. At present seismic observation data is individually analyzed by the Kelunji system, the CEA system and RIMES. The JICA Study Team recommended that the two systems should be integrated to improve the accuracy of hypocenter and magnitude determination. It is also necessary to develop the engineers' capacity to operate the earthquake and tsunami monitoring system.

The strong motion accelerographs were installed at 11 observatories by JICA, and strong motion observation has been conducted by the DMH. However, each observatory does not assess the validity of observation data, and the headquarters of the DMH does not analyze such data transmitted from each observatory. Hence, data analysis necessary for seismic resistant design has not been conducted yet. The DMH considers the need to develop their human resources for strong motion accelerograph observation and data analysis.

Regarding tsunami observation, there are only two tide gauges installed in Myanmar by the Hawaii Sea Level Center. Coupled with the fact that the number of gauges is not enough, the DMH do not receive observation data directly. Hence, the DMH needs to access the HP of Hawaii University to acquire the data. Under such circumstance, a tsunami warning is disseminated based on information from foreign observation agencies and international organizations through GTS, even though a local tsunami occurred near the coast. Therefore, warning information will not be issued timely for the public to evacuate.

As such, the JICA Study Team recommended strengthening of the seismic observation network, installation of tsunami observation instruments (buoy, submarine cable, etc.), and development of human resources.

(4) Preparedness / Prevention and Mitigation

As mentioned above, seismic observation and risk assessment in Myanmar are at a beginning stage. The JICA Study Team recommended preparation of an earthquake disaster management plan for main cities including Yangon and Naypyidaw based on hazard identification, risk assessment and impact analysis. At first, earthquake hazard mapping and impact analysis need to be conducted, and then based on these results, earthquake disaster management plan has to be formulated, that includes plan of structural and non-structural measures. With economic growth in urban areas, the quake resistance standards and seismic resistant design have to be established and reviewed.

In the delta area where the tsunami in 2004 and the cyclone Nargis caused damage, the tsunami evacuation shelters were built using donated funds from the citizens and private companies. However, such tsunami shelters have not been built in coastal cities including Sittwe along the west coast; instead a pagoda (temple) on a hill has been utilized as the evacuation facility. In the areas mentioned above, a tsunami evacuation drill in which many citizens participated was conducted by the DMH and local government in October 2011.

The Myanmar government has promoted mangrove plantation as a countermeasure to reduce tsunami damage along the front coast of the delta area.

(5) Emergency Response

At present, the emergency response procedure in case of an earthquake has not been prepared in Myanmar even in main cities including Yangon and Naypyidaw. As compared with floods which occur frequently, earthquakes and tsunamis which occur rarely tend to be neglected even if its damages are usually very large-scale. Thus, the JICA Study Team recommended that Myanmar indispensably makes continuous efforts to maintain public awareness, education, and advocacy.

The tsunami evacuation shelters were built in tsunami and high tide disaster areas, and the evacuation drills including provision of relief supplies were conducted. Evacuation sign boards showing evacuation routes and sites, and warning facilities such as sirens and loud speakers have yet to be installed in many disaster prone areas.

(6) Issues and Needs

1) Issues[54]

a) Develop and improve the seismic monitoring system and strengthen the monitoring and operation staff of the DMH.
b) Make a nationwide strategy and policy for earthquake and tsunami disaster management.

2) Needs[55]

a) Development of earthquake and tsunami observation network and capacity development of observation.
b) Formulation of a disaster management plan and BCP for the main cities.

6.2.6 Philippines

(1) Present Situation of Earthquake and Tsunami Disaster

The Philippines is located on the seduction zone of the Philippine Sea Plate and the Eurasian Plate. The Philippines Sea Plate is subducting underneath the Philippine archipelago from east

[54] All views were identified by NDMC in the interview with the JICA Study Team.
[55] All views are attributed to the JICA Study Team.

to west at the east side. On the other hand, the Eurasian Plate is subducting underneath the Philippine archipelago from west to east at the west side. There are many inland active faults in the Philippines. Especially, the Philippine Fault longitudinally traversing the middle part of the archipelago divides the territory into the east and west sides. A large number of various scale earthquakes have occurred in the Philippines. One of the most significant natural hazards to be monitored is the earthquake, because large-scale earthquakes have occurred time and again. Such large-scale earthquakes include the one which occurred in seas off the coast of Mindanao Island in 1976 (M=7.9 and 4,791 deaths), the Luzon Island Earthquake in 1990 (M=7.9 and 1,283 deaths), the Mindoro Island Earthquake and tsunami in 1994 (M=7.1 and 41 deaths), and the Negros Island Earthquake in 2012 (M=6.9 and 51 deaths).

The coastlines of the Philippines total to about 34,000 km. In this regard, significant tsunami disasters caused by earthquakes are anticipated. The tsunamis which occurred around Mindanao Island killed 41 people in 1994 and seven people in 2002.

Table 6.2.4 shows records of main earthquake occurrences in the Philippines.

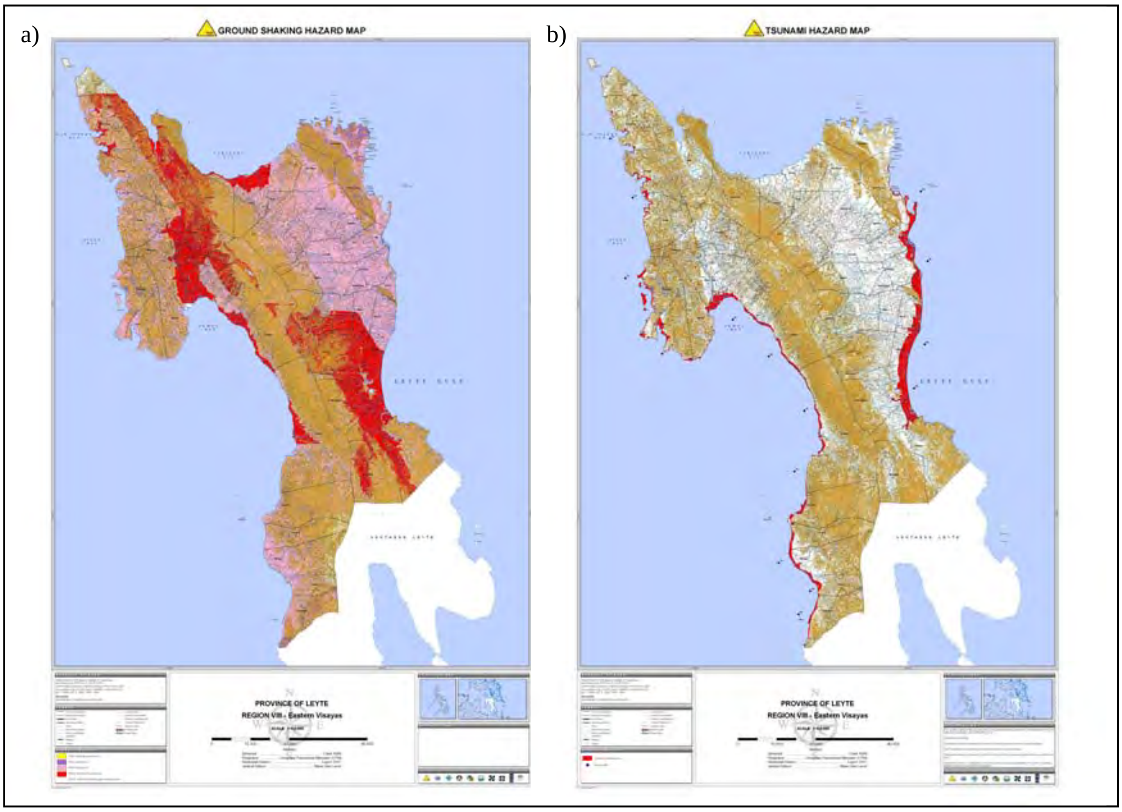
Table 6.2.4 Main Earthquake/Tsunami Disaster History in the Philippines

Date	Location	Comment	Mag.	Source
1976/8/16	Moro Gulf	Tsunami occurred. 3700 people died, 8000 people were injured, affected 12,000 households. PHP 0.276 billion worth of damage.		2
1990/7/16	Luzon	A massive earthquake struck Luzon area and Samar provinces. The earthquake caused 1283 death and 2786 injured. It is reported that 1,225,248 people and 227,918 households were affected by the earthquake. PHP 12.226 billion worth of damage.		1
1994/11/14	Mindoro	Tsunami occurred. 41 people died, 430 people were injured, affected 22,452 households. PHP 0.515 billion worth of damage.		2
1999/12/12	Luzon (Manila Region)	Northern provinces in the Philippines were jolted by a strong tremor. The earthquake produced 6 casualties and 40 injured.		1
2002/3/5	Mindanao	Tsunami occurred. 7 people died. PHP 1.714 billion worth of damage		3
2007/5/6	Ilocos	Orange earthquake alert in the Philippines. No casualties and little damage expected. More information on GDACS	5.5	1
2009/9/19	South Cotabato	Two earthquake incidents both of tectonic origin occurred on September 18 and 19, 2009 in South Cotabato. 76 houses damaged, 91 people injured.		1
2012/2/6	Negros	51 people died, 62 were missing, 112 were injured, 320,165 people affected, 6352 houses collapsed, 9435 houses were partly destroyed.	6.9	4

Source: (1) Asian Disaster Reduction Centre (ADRC), GLobal IDEntifier Number (GLIDE) http://www.glidenumber.net/glide/public/search/search.jsp,
(2) PHIVOLCS (http://www.phivolcs.dost.gov.ph),
(3) National Oceanic and Atmospheric Administration (NOAA) National Geophysical Data Center (NGDC) http://www.ngdc.noaa.gov/hazard/earthqk.shtml,
(4) Philippines News Agency (http://www.pna.gov.ph/index.php)

(2) Risk Assessment

The hazard maps of 22 provinces have been developed in the READY Project with assistance from the UNDP and AusAID. CBDRMs including development of evacuation plans were supported in the READY Project based on the hazard maps. Figure 6.2.15 shows one of the hazard maps for earthquake and tsunami disaster in the western part of Visayan Islands, Philippines.



Source: PHIVOLCS (2007)

Figure 6.2.15 a) Earthquake Ground Shaking Hazard Map, b) Tsunami Hazards Map

The microzoning hazard maps of Metro Manila with scale of 1:5,000 were developed in the JICA development study "Earthquake Impact Reduction Study for Metropolitan Manila, Republic of the Philippines" conducted in 2004. PHIVOLCS initiated the upgrading of the microzoning hazard map by itself for completion in 2013.

PHIVOLCS conducted tsunami simulations in the "Tsunami Mitigation Program" from 2006 to 2007. Based on the simulations, tsunami hazard maps with scales of 1:100,000 to 1:50,000 in the three islands of Luzon, Mindanao, and Visayas were developed.

PHIVOLCS has also produced the software Rapid Earthquake Damage Assessment (REDAS) which anticipates seismic damages after a strong earthquake occurs. They held training seminars on REDAS in local government units (LGUs) and other relevant authorities in order to promote REDAS to other organizations.

The SATREPS project "Enhancement of Earthquake and Volcano Monitoring and Effective Utilization of Disaster Mitigation Information Project" has been conducted by JICA and JST form 2010 to 2015. The project aims to assist tsunami simulations for various cases and to produce a database.

The JICA Study Team recommended to develop microzoning hazard maps similar to the one made for Metro Manila for other cities such as Cebu and Davao with populations of over one million, where there is the threat of a large-scale earthquake and tsunami. And preparedness such as hazard mapping has yet to be developed in comparison with city's development. There is a need to develop regional disaster management plans based on these hazard maps[56].

Since PHIVOLCS has upgraded the microzoning hazard maps of Metro Manila by itself, the JICA Study Team also recommended that the development of microzoning maps of local cities should be initiated by PHIVOLCS.

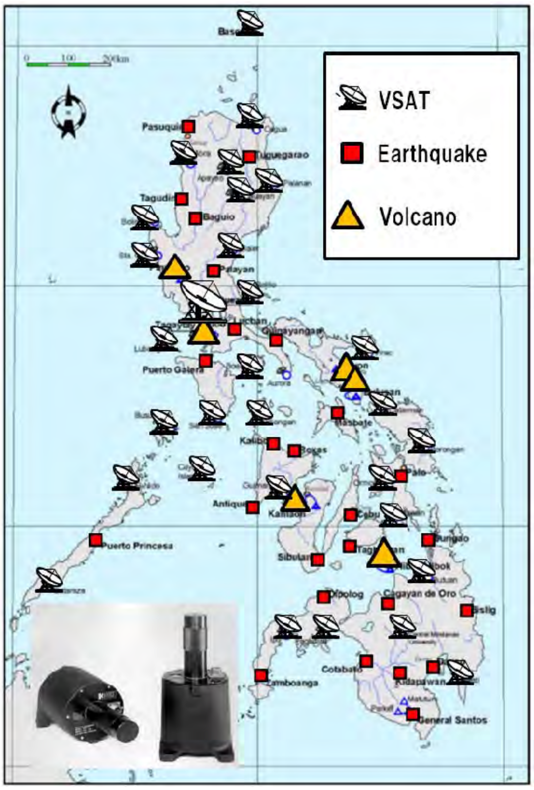
(3) Monitoring / Early Warning System

PHIVOLCS has a total of 66 seismological observatories (Figure 6.2.16), comprised of which 30 manned seismic observatories, 30 unmanned seismic observatories, and six observatories in Metro Manila. PHIVOLCS has planned to increase the number by at least 85 seismological observatories by 2016. The SATREPS project “Enhancement of Earthquake and Volcano Monitoring and Effective Utilization of Disaster Mitigation Information Project” by JICA and JST plans to provide 100 broadband seismographs and ten strong motion accelerographs. The accuracy of hypocenter and magnitude determination shall be improved by improvement of seismic observation density and upgrading of devices.

The software EQ-Plotter and REDAS developed by PHIVOLCS and PCIEERD can determine hypocenters and magnitudes, and anticipate damage automatically in case of an earthquake. PHIVOLCS disseminates earthquake information within 15 minutes after an earthquake.

Regarding tsunami observation, PHIVOLCS has one tsunami detecting instrument called “WET sensor” used for monitoring. PHIVOLCS disseminates tsunami warning through mass media (TV and radio) and to the OCD and LGUs.

PHIVOLCS has planned to increase five tsunami WET sensors. NAMRIA has been observing tide levels with high accuracy at 18 stations. It is necessary to cooperate with each other to utilize tide observation for tsunami warning.



Source: PHIVOLCS, *Enhancement of Earthquake and Volcano Monitoring and Effective Utilization of Disaster Mitigation Information in the Philippines (2010 – 2014)* (PPT, 3)

Figure 6.2.16 Seismic Observation System Location Map

[56] All views are attributed to the JICA Study Team.

Tsunami information has been acquired from international agencies including the Japan Meteorological Agency (JWA) and the Pacific Tsunami Warning Center (PTWC). Since the WET sensor was designed to detect tsunami occurrence only along coastal areas, it does not detect a local tsunami occurring in the sea around the Philippines before the tsunami arrives. The JICA Study Team recommended installing new tsunami detecting buoys or submarine cables.

Earthquakes occurring in the sea around the Philippines probably trigger tsunamis that could hit and largely damage its surrounding countries such as Malaysia, Vietnam, Brunei, Singapore, Taiwan, and China, at areas facing the South China Sea. Therefore, the JICA Study Team recommended that these countries share information and strengthen cooperation in earthquake and tsunami observation among neighboring countries.

(4) Preparedness / Prevention and Mitigation

A law regarding quake resistance standards was enacted in 1992 and amended in 2004. Basic seismic intensity was decided based on local standards in the Philippines and seismic resistant design was established following AASHTO of the US. In Metro Manila, hazardous areas where liquefaction is anticipated have been limited from constructing public buildings and structures.

The Department of Public Works and Highways (DPWH) doesn’t have sufficient knowledge and experience of aseismic design for bridge, and has yet to establish appropriate standard and technology for improvement of aseismic construction. DPWH has independently conducted retrofitting works for bridges. However, the measures done were at a basic and minor level, such as collapse preventive devices of bridge girder and patching on bridge pier. The DPWH has also constructed a seawall for high tides and storm surges on the coastal area of Roxas Boulevard in Manila.

In a JICA development project regarding improvement of bridges for mitigation of large-scale earthquake impact, there is plan on conducting a study on quake resistance, draft revision of seismic resistant design standards, and technical transfer for seismic strengthening works of bridges in and around Metro Manila. Based on the project, there is a need to reinforce important public structures against earthquake, train engineers for aseismic design, and support public awareness for aseismic design and reinforcing buildings against earthquake[57].

The JICA Study Team recommended that, based on implemented risk assessment, important infrastructure such as for transportation, and port, school, hospital and government buildings should be strengthened against seismic disaster. Similarly, preparedness to tsunami disaster is needed based on risk assessment and impact analysis along the coastal areas.

(5) Emergency Response

The OCD, PHIVOLCS and relevant authorities have published a pamphlet, poster, and video, and also conducted nationwide earthquake evacuation drills targeting school. The evacuation

[57] All views are attributed to the JICA Study Team.

plan and evacuation route signboards based on the tsunami hazard maps created in the READY Project have been developed.

The MMDA established contingency plans and developed emergency response plans, and also prepared essential materials and equipment for disaster rescue and relief.

(6) Issues and Needs

1) Issues[58]

a) Improve the accuracy of hypocenter and magnitude determination by increasing seismic observation density and upgrading of devices.
b) Review and upgrade the earthquake damage estimation for Metro Manila including its surrounding areas, and reinforcement of important public structures against earthquake based on the upgraded estimation.
c) Assess earthquake damage and to establish disaster management plans in large local cities such as Cebu and Davao.

2) Needs[59]

a) Enhancement of earthquake and tsunami monitoring networks.
b) Integrated urban disaster management plan for Metropolitan Manila and its surrounding area. (including earthquake damage estimation, reinforcement against earthquake and public awareness.)
c) Earthquake damage estimation and integrated urban disaster management for large local cities such as Cebu and Davao.

6.2.7 Singapore

Singapore is an urbanized country composed of a main island (42 km by 23 km in size) and 62 small islands. Natural disasters such as urban flooding occur in limited areas. Historically, earthquake and tsunami disasters of any significant scale have not been recorded. Even so, Singapore is one of the most developed countries in the world having a high level of GDP per capita. Singapore has reached a significant level in the field of disaster management in terms of researches, technologies, practices and skills.

The Study considers that Singapore is one of the ASEAN countries which offer technical and financial support to other ASEAN countries in the field of disaster management for regional collaboration.

The Singapore Civil Defense Office (SCDF) is the responsible agency for disaster management in Singapore. This agency has accumulated technical know-how on urban disaster management such as search and rescue, management of toxic materials, and urban firefighting.

The SCDF is an active contributor to UN humanitarian and disaster relief efforts, in particular the activities of the International Search and Rescue Advisory Group (INSARAG) in the Asia-Pacific region. The SCDF also maintains an active role in engaging ASEAN on capacity

58 All views were identified by PHIVOLCS in the interview with the JICA Study Team.
59 All views are attributed to the JICA Study Team.

building, through the ASEAN Committee on Disaster Management (ACDM) and the annual ASEAN Regional Disaster Emergency Response Simulation Exercise (ARDEX). Inasmuch as the present activities, Singapore will continue to be active jn capacity building on disaster management in ASEAN countries.

6.2.8 Thailand

(1) Present Situation of Earthquake and Tsunami Disaster

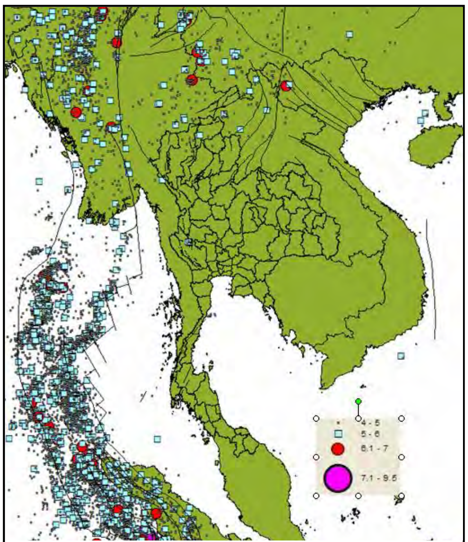
Thailand is located on the southeast part of the Eurasian Plate, wherein a few earthquakes have occurred. A large-scale earthquake has not yet occurred according to historical records. According to observation results in recent years, only relatively small-scale earthquakes of less than 6.5 on the Richter scale have occurred in the northern and western areas of Thailand.

Table 6.2.5 shows the recorded earthquakes with magnitudes of more than 5.0. Figure 6.2.17 shows the distribution of epicenters in and around Thailand.

Table 6.2.5 History of Major Earthquakes (M>5.0)

Date	Place	Magnitude (Richter)
May 13, 1935	Southern part of Thailand	6.5
February 17, 1975	Tha Song Yang District, Tak Province	5.6
April 15-22, 1983	Muang Si Sawat, Kanchanaburi	5.3, 5.9, 5.2
September 11, 1994	Phan, Chiang Rai	5.1
December 9, 1995	Kwang Mon	5.1
December 21, 1995	Tue Chang Rai	5.2
December 22, 1996	Lao PDR-Thailand-Myanmar border	5.5

Source: DMR, *Earthquake, tsunami in Thailand*.(PPT, 25)



Source: TMD, *National Earthquake Monitoring for Tsunami Early Warning*, (PPT, 3)

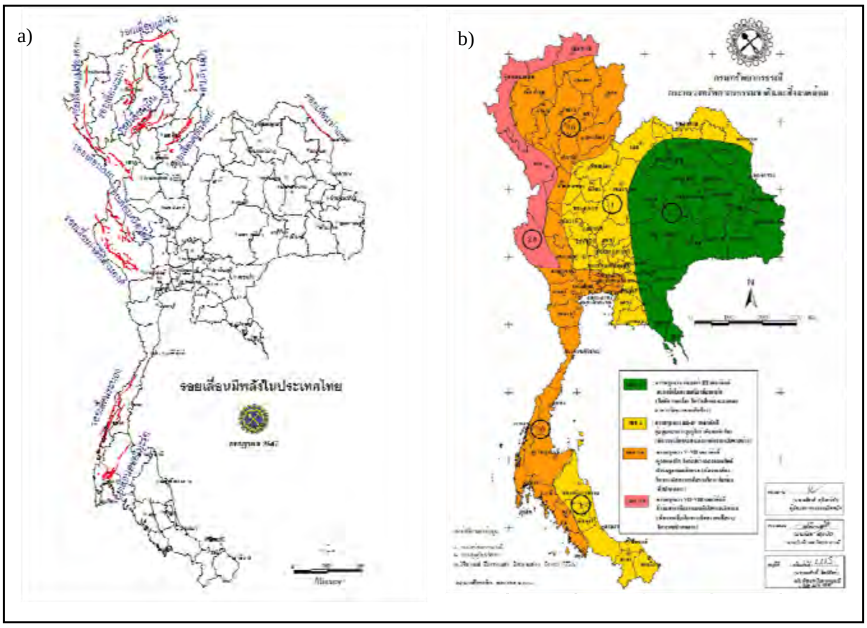
Figure 6.2.17 Epicentre Distribution Map

The tsunami caused by the earthquake in the Indian Ocean off the coast of Sumatra in 2004 hit six prefectures in southern Thailand including Phuket, and caused 5,305 deaths. According to studies on tsunami sediments, a tsunami caused by an earthquake with almost the same scale as the one in the Indian Ocean off the coast of Sumatra in 2004 was considered to have been occurring once every 500 to 700 years in the southern area of Thailand. After the earthquake in 2004, tsunami disaster has been one of the significant disasters of Thailand, and some disaster prevention measures have been implemented.

(2) Risk Assessment

The DMR has produced an active fault distribution map (Figure 6.2.18 a), and also an earthquake risk map which assessed risk in four levels (Figure 6.2.18 b). Bangkok was assessed to be of second level because it has soft foundation with a thick layer of alluvium underneath, even though there is no hypocenter around Bangkok. The DMR has conducted a survey not only about active fault distribution but also their past activities through trench surveys. The JICA Study Team recommended developing microzoning hazard maps for major cities in the northern and western parts of Thailand.

Tsunami hazard maps with scale of 1:5,000 for the six prefectures of southern Thailand have been developed based on tsunami risk assessment. Tsunami damages not only due to earthquake but also volcanic activity including volcanic sector collapse have been anticipated in Nicobar Island in Andaman Sea based on tsunami simulation. Tsunami evacuation drills are being conducted in schools and hotels once a year. However, since the information for tsunami warnings mainly depends on information from organizations and institutions abroad, Thailand's own tsunami observation network has to be strengthened.



Source: DMW, *Earthquake, tsunami in Thailand*.(PPT, a) 29, b) 54)

Figure 6.2.18 a) Active Fault Distribution Map b) Earthquake Risk Map

(3) Monitoring / Early Warning System

The earthquake and tsunami observation network of Thailand has been implemented and strengthened after the catastrophe brought by the tsunami in 2004. The following observation network has been developed. The TMD installed a total of 41 broadband seismographs using its own budget (Figure 6.2.19), 15 seismographs manufactured in Canada (Phase-1 from 2006), and 26 seismographs manufactured in Australia (Phase-2 from 2009).

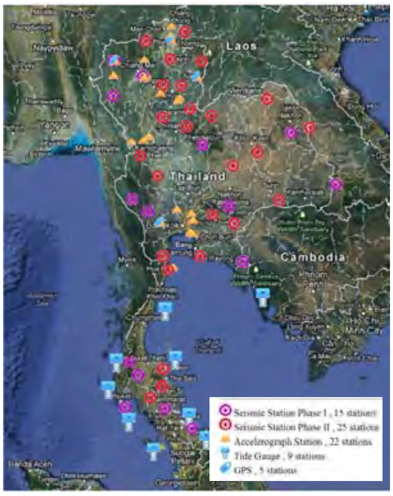


Figure 6.2.19
Seismic Observation Location Map
Source: TMD
(http://www.seismology.tmd.go.th/en/stations.php)

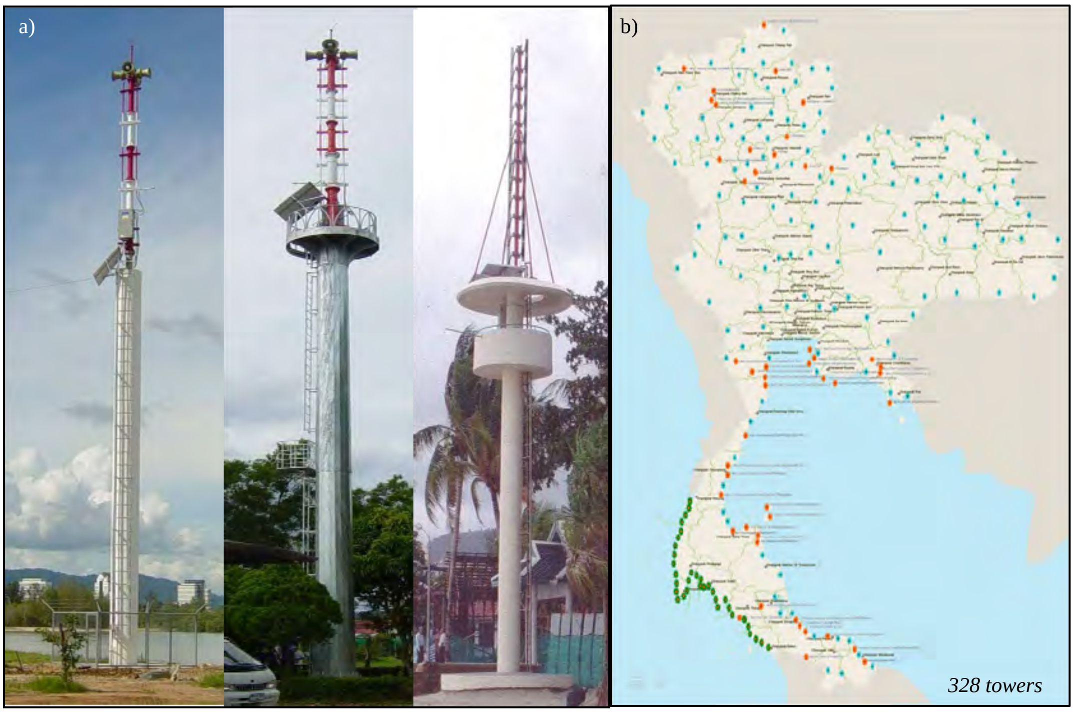
- Broadband seismograph 41 stations

- Strong motion accelerograph 22 stations
- GPS observation 5 stations
- Tide gauge observation 9 stations
- Tsunami observation buoy 3 stations

The TMD has a plan to increase the number of stations by 20 each for broadband seismograph and strong motion accelerograph using its budget for the next fiscal year (2013). The number of observation stations is especially increased at the southern area of Thailand, where seismic observation density is low.

Hypocenter and magnitude determination has been conducted by the TMD using the software “SeisComp3”, which was manufactured in Germany based on seismic observation results. The TMD makes the calculations in about ten minutes. In case of an earthquake abroad, it takes about 15 minutes to analyze information through GTS operated by the World Meteorological Organization (WMO).

The tsunami observation buoys were installed under the DART Project as carried out by the US in 2006. One of the three tsunami observation buoys was broken due to the tsunami generated by the 7.4 magnitude earthquake in 2010. This buoy is still not working at present. Maintenance costs amounts to a total of THB 30 million since buoys need to be fixed or repaired in case a fishing boat crashes into them.



Source: NDWC, *Operational Center of NDWC,* (PPT, a) 22, b) 28)

Figure 6.2.20 a) Warning Tower, b) Warning Tower Location Map

The TMD disseminates earthquake and tsunami information to mass media and relevant authorities via fax and SMS within about 15 minutes after an earthquake occurs. After the earthquake in the Indian Ocean off the coast of Sumatra in 2004, warning towers have been built in 328 sites not only in tsunami disaster areas but throughout the entire country including mountainous areas (Figure 6.2.20). The warning towers along Andaman Coast were built in beaches and parks, and on the roof of hotel buildings. A warning tower is capable of transmitting warnings within a 1.0 to 1.5 km radius, and is equipped with a siren, loudspeaker, and solar panel and battery. In the international resort area of Phuket, warnings are issued in five languages, namely English, German, Chinese, Japanese, and Thai.

An earthquake centered in Myanmar or Lao PDR could cause some damage in Thailand. However, the seismic observation networks of Myanmar and Lao PDR are less developed than those of Thailand. The JICA Study Team recommended that Thailand should lead the observation network with RIMES and the ASEAN Earthquake Information Center (AEIC) which comprehensively monitors earthquakes in Thailand and surrounding countries. Similarly, the tsunami observation system shall be operated in cooperation with IOTWS and InaTEWS of the BMKG in Indonesia.

According to the TMD, there is a need to increase the number of buoys for early detection of tsunami occurrence and identification of the tsunami scale, or to install a new tsunami observation system including submarine cables in order to reduce maintenance costs.

(4) Preparedness / Prevention and Mitigation

The law regarding quake resistance standards was enacted in 1997 but it was applicable only to ten prefectures. The law was amended in 2007 to increase the applied areas from 10 to 22 prefectures based on distribution of active faults and soft/unconsolidated foundation.

A considerable number of warning towers and tsunami shelters have been built in tsunami disaster areas.

(5) Emergency Response

In case an earthquake and/or a tsunami occur, the NDWC is responsible for disseminating warnings through the warning system such as the warning towers. Such warnings are based on information and observation results provided by the TMD and/or international organizations.

(6) Issues and Needs

1) Issues[60]

a) Strengthen the earthquake and tsunami monitoring system especially in the areas near Lao PDR and Myanmar, and the coastal area of southern Thailand.

2) Needs[61]

a) Study on the development of an earthquake monitoring system and a disaster prevention plan.

[60] All views were identified by the TMD in the interview with the JICA Study Team.
[61] All views are attributed to the JICA Study Team.

6.2.9 Vietnam

(1) Present Situation of Earthquake and Tsunami Disaster

In Vietnam, earthquake and tsunami disasters are not special events. The geological map of Vietnam shows that it has many fault lines. One of the famous faults is located along the Red River running from southeast to northwest.

Historically, an earthquake of 6.5 magnitudes was recorded. Earthquake experts of Vietnam consider the possibility of stronger earthquakes occurring along this fault.

In relation to tsunami disasters, Vietnam’s Tsunami Monitoring Center is operational in Hanoi. A limited number of seismographs are installed and connected in this center. Earthquake events are displayed on large displays at real time. The entire system including hardware and software was imported from New Zealand. The center monitors earthquakes and tsunamis for 24 hours in areas including the South China Sea, Taiwan, Japan, and the Philippines.

(2) Risk Assessment

Earthquake risk assessment in Vietnam has yet to be conducted. The availability of seismic building codes applied to residential buildings is not clear. Apparently, buildings vulnerable to earthquake shock are seen and being constructed throughout Hanoi. Should an earthquake with magnitude of more than 6.0 occur near or within Hanoi, such buildings would be severely damaged.

Therefore, earthquake research in the Hanoi area is foremost recommended, and then followed by building damage assessment. If necessary, strict building codes and a construction permission system should be implemented.

(3) Monitoring / Early Warning System

Broadband seismographs will be installed at 15 other stations in Vietnam. New seismographs will be connected with the existing system.

A tsunami forecasting and monitoring system has not been fully installed yet. At present, only the tsunami monitoring and warning system in Da Nang is operational.

According to researches made by tsunami disaster experts, tsunami waves generated by the Manila Trench could reach the central coast of Vietnam such as Da Nang. Wave heights were estimated to range from around 3 to 5 m at Da Nang. More tsunami forecasting and warning systems are necessary along the coastal areas of the central part of Vietnam. Also, community disaster management drills such as evacuation exercises should be conducted at a regular basis in tsunami expected areas.

(4) Preparedness / Prevention and Mitigation

For effective disaster management, an integrated disaster management plan or detailed regional disaster management plan should be prepared as a guideline. In order to achieve this, scientific research and data accumulation are important.

In Vietnam, a detailed disaster management plan has not been prepared yet for earthquake and tsunami. For disaster preparedness and necessary mitigation measures, a disaster management plan should be formulated.

(5) Emergency Response

Based on scenario earthquakes or tsunamis, CBDRM should be conducted at a regular schedule in disaster expected areas. Warning system should also be constructed thoroughly and operated effectively.

1) Issues[62]

a) Conduct risk assessment of tsunami disaster along the central coast of Vietnam such as Da Nang, and strengthen the existing tsunami monitoring system.

2) Needs[63]

a) Formulation of a tsunami disaster management plan including disaster risk assessment, and proposal of tsunami monitoring and early warning systems.
b) Regional collaborative research on the mechanism and characteristics of earthquakes and tsunamis induced by the Manila Trench.

6.2.10 International Networks for Earthquake/Tsunami Monitoring and Early Warning

In Asia -Pacific Region several networks for monitoring and early warning have been established.

PTWC in Hawaii, US as the primarily operational headquarters for the “Pacific Tsunami Warning System”, provides warnings for Pacific basin tele-tsunamis (tsunamis that can cause damage far away from their source) to almost every country around the Pacific rim and to most of the Pacific island states. PTWC is the interim warning center for the IOTWS and to the countries bordering the South China Sea (Brunei, Cambodia, Indonesia, Malaysia, Philippines, Singapore, Thailand, Vietnam, China, Macao, Hog Kong and Taiwan)

NWPTAC in Tokyo, Japan is a regional tsunami warning center for the northwest Pacific region including South China Sea. The provision of NWPTAC service is aimed at allowing recipient countries to take timely and appropriate action against tsunami threats in conjunction with tsunami bulletins from the PTWC.

Functions and Feature of the identified tsunami monitoring network is listed Table 6.2.6.

[62] All views were identified by the DDMFSC in the interview with the JICA Study Team.
[63] All views are attributed to the JICA Study Team.

Table 6.2.6 International Agency/System for Earthquake/Tsunami

Name	1. Location 2. Funder 3. Date of Foundation	Member Countries	Function/Features
AEIC	1. Jakarta, Indonesia 1. ASEAN 2. ?	ASEAN 9 countries; Brunei, Indonesia, Lao PDR, Malaysia, Myanmar, Philippines, Singapore, Thailand, Vietnam	- Offering information related to earthquakes and their history with foals for the future. Earthquake facilities and networks can be also available - Information on actual activities are not know
WMO	1. Geneva, Swiss 2. United Nation 3. 1950	183 countries and 6 territories including ASEAN 10 countries	- Disseminate not only meteorological information but also seismic parametric data, tidal data and forecast and warning of tsunami through Global Telecommunication System
RIMES	1. Secretarial: Huluhule, Maldives Early Warming facility/program Unit: Pathumthani, 2. Thailand 3. 30 April 2009	26 countries along the Indian Ocean and South China Sea regions, including 7 ASEAN countries; Cambodia, Indonesia, Lao PDR, Myanmar, Philippine, Thailand, Vietnam	- Provide earthquake alert and tsunami watch service, - The center is operational 24 hours a day, 7days a week and is assigned 2 watch standers per shift, - Provide regional tsunami early warning, - Incorporate tsunami early warning into existing national warning systems through its interrelated components including regional tsunami and earthquake monitoring, advisory dissemination, decision-support tool development. Potential impact and risk assessments ans other related research on trans-boundary hazard. - The RIMES Tsunami Watch Center has own monitoring stations)
PTWC	1. Hawaii, US 2. NOAA, ICG/ITSU 3. 1949 after Aleutian Tsunami in 1946	Countries along the Pacific ocean, Indian Ocean and Caribbean Sea	- Supervise the tsunami forecast and disseminate tsunami warning, - Verify the occurrence of tsunami by analyzing tidal data around the epicenter within tsunami arrival time - PTWC is the interim warning center for the IOTWS and to the countries bordering the South China Sea (Brunei, Cambodia, Indonesia, Malaysia, Philippines, Singapore, Thailand, Vietnam, China, Macao, Hog Kong and Taiwan) - Tsunami detection sensor; DART (Deep-ocean Assessment and Reporting of Tsunami; Tsunami buoy)
NWPTAC	1. Tokyo, Japan 2. JMA 3. 28 March 2005	Countries along the northwestern Pacific	- North West Pacific Tsunami Advisory (NWPT) at 65 forecast points is issued when NWPTAC detects and earthquake of magnitude 6.5 or greater, - The NWPTA contains; (1) earthquake information; (2) tsunamigetic potential; (3) the estimated amplitude and arrival time of the tsunami; and (4) observation of the tsunami
IOTWS	1. Hawaii, US 2. USAID 3. 1 August 2005 after Sumatra earthquake in 2004	24 countries along the Indian Ocean (as of October 2011)	- Forecast tsunami in Indian sea and clarify its scale based on sea seixminc and sea level monitoring system when earthquake occurs - Conduct end-to-end early warning system to disseminate tsunami information, assessed risk and warning message - BoM of Australia, INCOIS of India and BMKG of Indonesia provide information to the member countries,
InaTWS	1. Jakarta, Indonesia 2. BMKG	Indonesia	- Seismic and tsunami observation in Indonesia
REDAS	1. Manila, Philippine 2. PHIVOLCS	Philippines	- Seismic and tsunami observation in Philippines
MNTEWC	1. Kuala Lumpur 2. MMD	Malaysia	- Seismic and tsunami observation in Philippines - (SAATNM in Malay language)

AEIC: http://aeic.bmg.go.id/index.asp (not accessible now); WMO: http://www.wmo.int/pages/index_en.html; RIMES: http://www.rimes.int/; PTWC: http://ptwc.weather.gov/; JWA NWPTAC: http://www.seisvol.kishou.go.jp/eq/int_tsunami/nwptac/indexe.html;

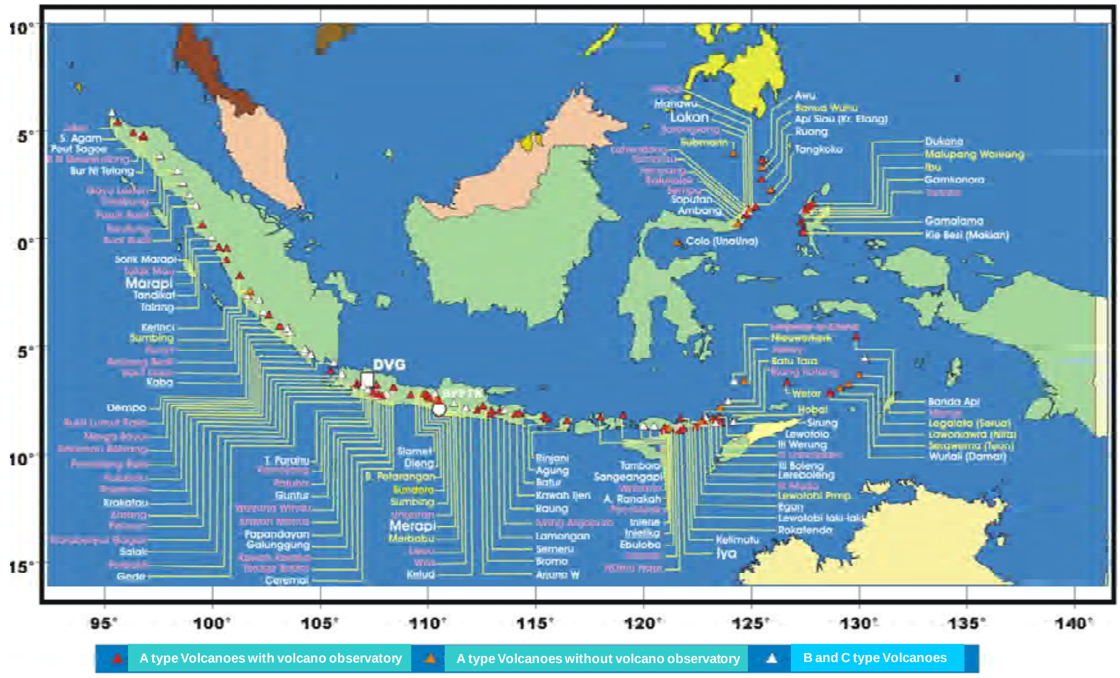
AEIC: ASEAN Earthquake Information Center
WMO: World Meteorological Organization
RIMES: Regional Integrated Multi-Hazard Early Warning System for Africa and Asia
PTWC: Pacific Tsunami Warning Center
NOAA; National Coordination and Atmospheric Administration
ICG/ITSU: International Coordination Group For the Tsunami Warning System in the Pacific (renamed to ICG/PTWS)
NWPTACS: Northwest Pacific Tsunami Advisory Center
ITOWS: Indian Ocean Tsunami Warning and Mitigation System
InaTWS; The Indonesian Tsunami Warning System
JMA: Japan Meteorological Agency
BoM: Bureau of Meteorology,
INCOIS: Indian national Center for Ocean Information Searvices
UNESCO/IOC: United National Educational, Scientific and Cultural Organizations /Intergovernmental Oceanographic Commission

6.3 Volcano

6.3.1 Indonesia

(1) Present Situation of Volcanic Disaster

Indonesia consists of many volcanic islands because the boundaries of tectonic plates are located around Indonesia. There are about 129 volcanoes in Indonesia, of which 80 are active volcanoes. Of all the volcanoes in the world, 13% are in Indonesia. The eruptions of Tambora Volcano in 1815 killed 92,000 people. The tsunami caused by sector collapse of the volcanic body with the eruption of Krakatau Volcano at Selat Sunda in 1883 killed 36,600 people. There are potential volcanic activities at Merapi, Semeru, Soputan, Karangetang, Ibu, Talang, Batur and Lokon Volcanoes. Merapi Volcano in Yogyakarta has erupted at short period of intervals, in 1994, 1997, 1998, 2001, 2006, and 2010.



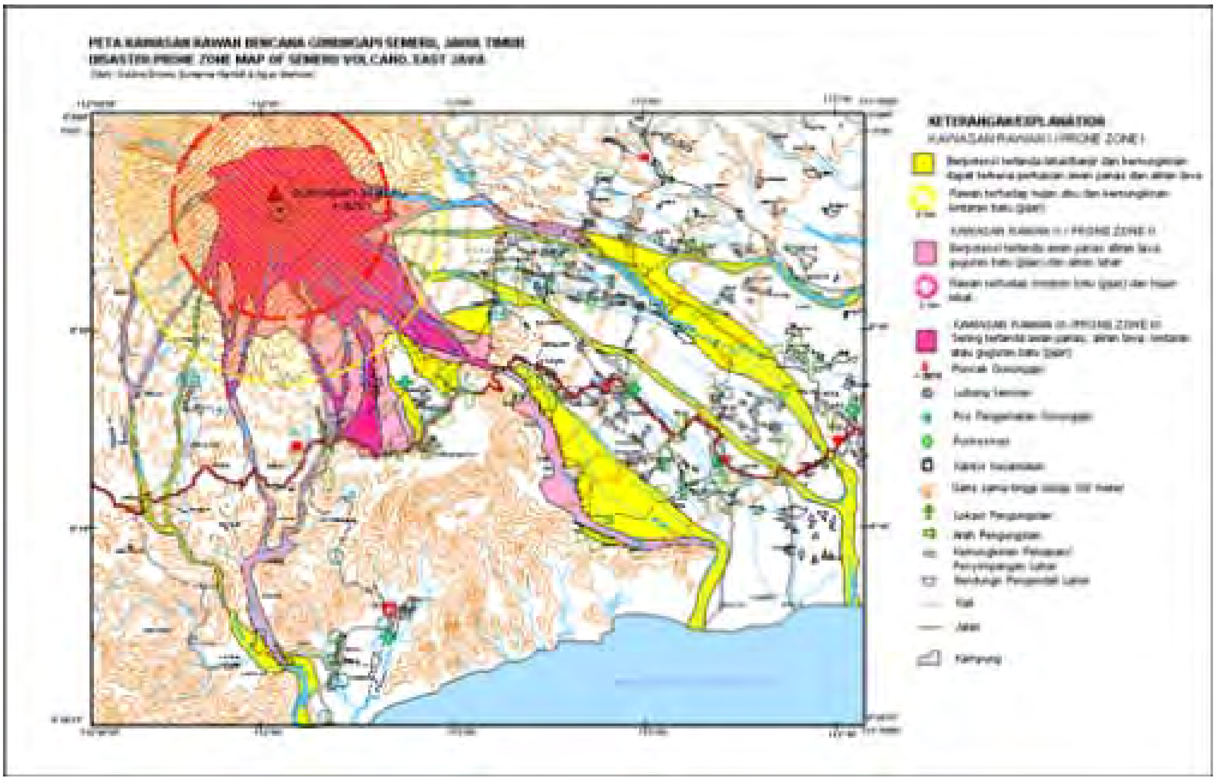
Note: A type is a volcano with minimum of one eruption after year 1600.
Source: CVGHM, Volcanic hazard mitigation in Indonesia (PPT Slide 3)

Figure 6.3.1 Distribution of Active Volcanoes in Indonesia

(2) Risk Assessment

Survey and monitoring activities of active volcanoes, such as creating geological maps, seismic observations, ground deformations, magnetic and gravity surveys and geochemical surveys, etc., have been conducted by the Center for Volcanology and Geological Hazard Mitigation (CVGHM).

The CVGHM has developed 80 hazard maps of volcanoes (Figure 6.3.2). The classification of volcanic hazardous areas in volcano hazard maps is shown in Table 6.3.1. Since Merapi Volcano is located on two provinces, the hazard map of Merapi Volcano was published in both maps of Yogyakarta and Central Java.



Source: CVGHM, Volcanic hazard mitigation in Indonesia (PPT Slide 12)

Figure 6.3.2 Disaster Prone Zone Map of Semeru Volcano in East Java

Table 6.3.1 Classification of Volcanic Hazardous Area in Volcanic Disaster Hazard Map

Classification	Explanation
Region I	Affected by secondary risk from eruption (lahars, ash clouds)
Region II	Affected by material eruption by climatic condition
Region III	Directory affected by material eruption (pyroclastic flow, debris, gasses)

Source: CVGHM, *Volcanic hazard mitigation in Indonesia* (PPT Slide 11) (summarized by the JICA Study Team)

(3) Monitoring / Early Warning System

The early warning system for volcanic eruption has been operated by the CVGHM. The classification of warning levels for volcanic eruption is shown in Table 6.3.2.

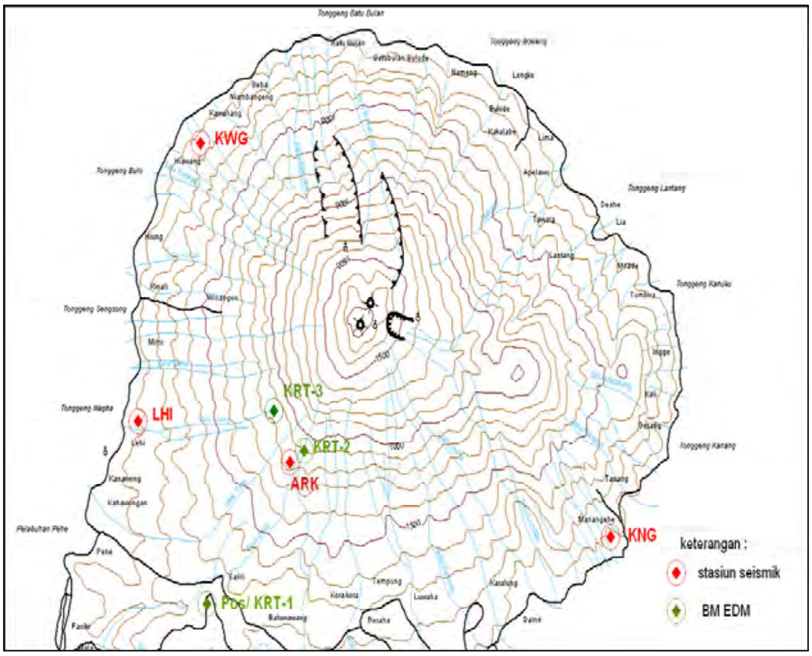
Table 6.3.2 Volcanic Activity Alert Level

Alert level	Condition
Level I: Normal	Volcanic activity stays in normal without any difference from its background levels.
Level II: Alert	Volcanic activity begins to increase and has pass over its background levels.
Level III: Stand by	Volcanic activity has shown its precursor before eruption.
Level IV: Danger	Started with volcanic ash eruption, and then approaching the main eruption.

Source: CVGHM, *Volcanic hazard mitigation in Indonesia* (PPT Slide 24) (summarized by the JICA Study Team)

Seismographs have been installed in all A type volcanoes. Such volcanoes are the ones which have had at least one eruption since year 1600. GPSs have been installed in five volcanoes and there are 75 monitoring stations collecting observation data. Maintenance of observation instruments are conducted by the CVGHM.

The volcanic observation system consists of seismograph, GPS, electro-optical distance measurement (EDM), tiltmeter, leveling and telescope (see Figure 6.3.3). According to the CVGHM, there is a need to increase the number and type of observation instruments and to improve the accuracy of volcanic eruption observation and prediction.



Source: CVGHM, Volcanic hazard mitigation in Indonesia (PPT Slide 17)

Figure 6.3.3 Seismic and EDM Network at Karangetang, July 2006

In general, when evacuation is planned, not only the result of risk assessment indicated in the hazard map but also the conditions of the local community such as tribe and religion need to be taken into account.

The new bridge across Selat Sunda has been planned; in connection with this, LIPI points that the eruption of Krakatau Volcano needs to be monitored with special care.

(4) Preparedness / Prevention and Mitigation

A database on all disasters in Indonesia called DIBI (Data dan Informasi Bencana Indonesia) has been developed and posted on the website of the BNPB (http://dibi.bnpb.go.id).

Relocation of communities from hazardous areas has been conducted in the rehabilitation and reconstruction program at Merapi.

In some areas where indigenous beliefs and traditional methods of preventing disaster are prevailing, the JICA Study Team recommended that risk reduction, scientific education and public awareness should be implemented considering and respecting these customs.

(5) Issues and Needs

1) Issues[64]

a) Increase the number and type of observation instruments, and improve the accuracy of volcanic eruption observation and prediction.

2) Needs[65]

a) Improvement/enhancement of the existing volcanic observation network

6.3.2 Philippines

(1) Present Situation of Volcanic Disaster

There are about 220 volcanoes in the Philippines that are located on the boundary of tectonic plates. There are 23 active volcanoes in the Philippines. Mayon Volcano has erupted actively within short periods of intervals in 1968, 1978, 1993, 2000, and 2001. When Mayon Volcano erupted in 1993, about 70 people died and more than 60,000 people evacuated. Pinatubo Volcano erupted in 1991 and debris flow occurred after the eruption, in which more than 900 people died or were missing and more than 90,000 evacuated.

Table 6.3.3 History of Major Volcanic Disasters in the Philippines

Date	Location	Comment	Data Source
1766/7/20	Mt. Mayon, Luzon	Debris flow/lahar of secondary disaster. 49 people died.	2
1814/2/1	Mt. Mayon, Luzon	Pyroclastic flow, debris flow/lahar, thunder. 1,200 people died.	2
1897/5/23	Mt. Mayon, Luzon	Pyroclastic flow, volcanic ash, debris flow/lahar. 350 people died.	2
1911/1/27	Mt. Taar, Luzon	Pyroclastic flow and tsunami. 1,335 people died.	2
1948/9/1	Mt. Hibok-Hibok, Mindanao	Pyroclastic flow. 68 people died.	2
1965/9/28	Mt. Taar, Luzon	Pyroclastic flow, tsunami. 200 people died.	2
1991/6/15	Mt. Pinatubo, Luzon	Pyroclastic flow, debris flow/lahar of secondary disaster, indirect damage of epidemic and famine. More than 900 people died or were missing.	2
1993/2/2	Mt. Mayon, Luzon	Pyroclastic flow. 70 people died. More than 60,000 refugees.	2
2006/8/14	Mt. Mayon	The discharge of lava flow from Mt. Mayon started to increase in mid-July and on August 4, lava flows extended 30 m beyond the 6 km radius region designated as the Permanent Danger Zone. The Philippine Institute of Volcanology and Seismology (PHIVOLCS) issued an official advisory on August 7 raising the alert level from 3 to 4. As of August 13, PHIVOLCS reported six eruptions occurred at Mayon Volcano during the previous 24 hours. Lahar following the eruption killed 1266 people.	1 2
2009/12/15	Mt. Mayon	A total of 12,415 persons evacuated as Mayon Volcano explodes.	1
2010/11/10	Bulusan Volcano in central Philippines	Bulusan Volcano has been ejecting ash and steam since November 6, 2010. According to the National Disaster Risk Reduction and Management Council (NDRRMC), at least 34 families, 205 persons, have already evacuated from Casiguran, Sorsogon so far.	1

Source: (1) Asian Disaster Reduction Centre (ADRC), GLobal IDEntifier Number (GLIDE) http://www.glidenumber.net/glide/public/search/search.jsp,
(2) National Oceanic and Atmospheric Administration (NOAA) National Geophysical Data Center (NGDC) http://www.ngdc.noaa.gov/hazard/earthqk.shtml

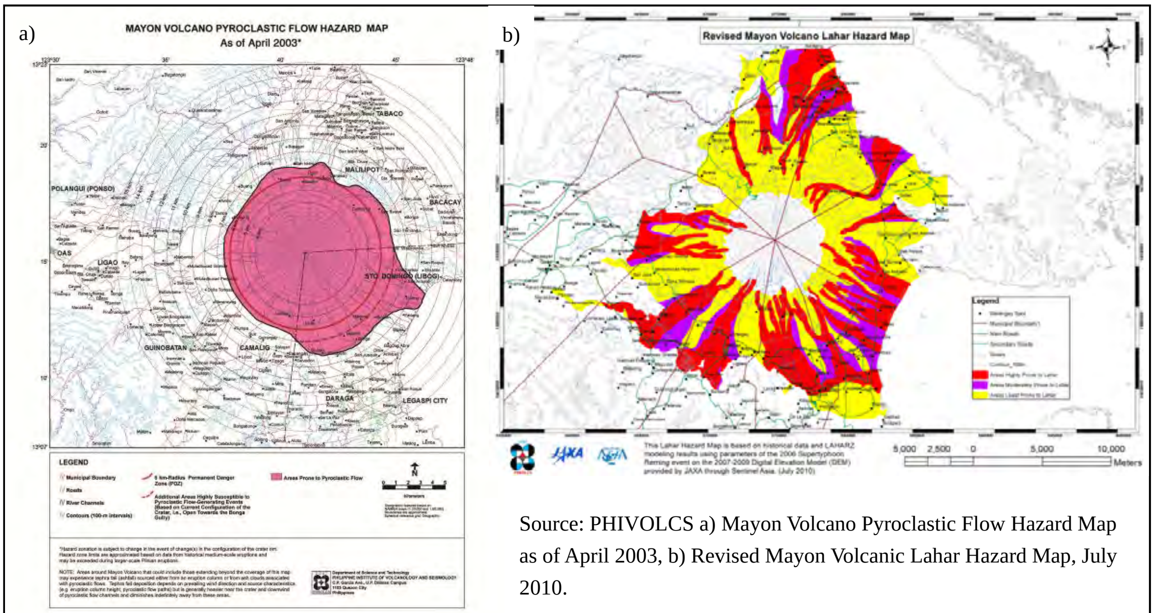
[64] All views were identified by the CVGHM in the interview with the JICA Study Team.
[65] All views are attributed to the JICA Study Team.

The eruption of Pinatubo Volcano in 1992 largely damaged not only buildings and infrastructures around the volcano but also aviation traffic due to ash fall, and has a huge impact on the local economy. Seven airports closed due to ash fall, and at least 16 commercial aircrafts encountered the ash cloud ejected by the June 15 eruption and a total of 10 engines were damaged and replaced. There is no accident of in-flight shutdown of an engine.

Table 6.3.3 shows the History of Major Volcanic Disasters in the Philippines.

(2) Risk Assessment

PHIVOLCS developed volcano hazard maps with scale of 1/25,000 for 14 out of the 23 active volcanoes. Figure 6.3.4 shows one of the volcano hazard maps. The hazard maps have been created to identify hazardous items such as volcanic ash, lava flow, pyroclastic flow, lahar, and volcanic mud flow, and utilize such for evacuation plans, quick response and land use. Since the existing hazard maps were created from a base map enlarged from 1:50,000 scale topographic maps surveyed by NAMRIA, the accuracy of topographic information is not adequate. PHIVOLCS mentioned in the interview with the JICA Study Team that there is a need to develop new large-scale topographic maps and to improve the accuracy of topographic information. Also, it is necessary to conduct a detailed survey of other active volcanoes which are possible to erupt, and to conduct preparedness activities for volcanic disaster prevention.



Source: PHIVOLCS a) Mayon Volcano Pyroclastic Flow Hazard Map as of April 2003, b) Revised Mayon Volcanic Lahar Hazard Map, July 2010.

Figure 6.3.4 Example of Volcanic Hazard Map; a) Pyroclastic Flow Hazard Map, b) Lahar Hazard Map of Mayon Volcano

(3) Monitoring / Early Warning System

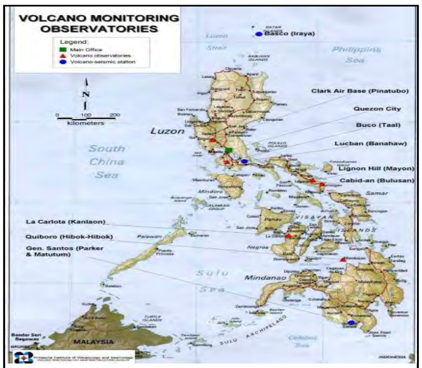
PHIVOLCS has set up observatories for six volcanoes and installed observation systems to monitor volcanic activity (see Figure 6.3.5). The observation sites and contents are shown below. PHIVOLCS installed one set of seismograph for the two volcanoes of Parker and Matutum. PHIVOLCS has started to observe there. The SATREPS project “Enhancement of

Earthquake and Volcano Monitoring and Effective Utilization of Disaster Mitigation Information Project" by JICA and JST has been conducted. In this project, it has been planned to install instruments such as broadband seismograph, low-frequency microphone and GPS at Taal and Mayon Volcanoes, and to monitor the said volcanoes.

- Taal, Pinatubo, Mayon, Bulusan, Hibok-hibok, Kanlaon.
- Ground shaking, ground deformation, gas and water quality analysis, specific resistance and electromagnetic ray.

PHIVOLCS issues warning alerts based on volcanic observations. Volcano alert levels are classified into five levels, and are established based on eruption type and local circumstances at each volcano.

PHIVOLCS hopes to strengthen the existing observation network for accurate eruption forecast necessary for long-term forecast, exact prediction and warning and evacuation order. Also, PHIVOLCS needs to develop volcanic observation networks for the active volcanoes which are not under observation.



Source: PHIVOLCS, *Overview of Monitoring Techniques in the Philippines,* (PPT, 2)

Figure 6.3.5 Volcanic Observatory Location Map

(4) Preparedness / Prevention and Mitigation

The DPWH has constructed structural measures such as sabo dams (check dams) and dykes (mega dikes, super dikes) at Pinatubo and Mayon volcanoes.

PHIVOLCS and the DPWH have conducted evacuation drills in CBDRM on a per project basis.

(5) Emergency Response

Since community-based disaster prevention plans have not yet been developed, emergency response has not been prepared systematically. The JICA Study Team recommended the development of a regional disaster prevention plan to clarify the procedures for emergency response in case of volcanic disaster, and also the promotion of emergency drills[67]. The resional disaster prevention plan should include a removal plan for accumulated volcanic ash, securement of power supply, relief plan with taking paralysis of traffic network into consideration.

(6) Issues and Needs

1) Issues[66]

- Expand the monitoring system to active volcanoes without observation instruments.

2) Needs[67]

- Expansion project of volcanic observation systems.

[66] All views are identified by PHIVOLCS in the interview with the JICA Study Team.
[67] All views are attributed to the JICA Study Team.

- Development of a regional disaster prevention plan.

6.4 Sediment Disaster

6.4.1 Indonesia

(1) Present Situation of Sediment Disaster

Since Indonesian islands are located on volcanic plate which mainly composed of weak and erosive volcanic body with many steep slopes, sediment disasters have occurred every year and inflicted big damages on human lives and infrastructure. The landslide disaster which occurred in Cililin, Bandung, West Java on April 21, 2004 killed 15 people, collapsed 21 houses, and severely damaged 22 houses, more than 60 ha of rice fields and 85 ha of plantations (see Figure 4.4.1). Around 70 houses were hit and 123 people were killed by the landslide on February 21, 2005. In April 2004, the landslide with 45m in width and 80m in length destroyed railway tracks in Malangbong, Garut, West Java. Landslide mainly occurs due to slope destabilization triggered by rainfall. Several earthquakes in Indonesia such as the Palolo earthquake (2005), Bantul earthquake (2006), Solok earthquake (2007), Muko-Muko earthquake (2007) and Painan earthquake (2007) have also triggered landslides.

Source: RISTEK, Science and technology as a principle of disaster management in Indonesia, pp.169, Figure 4.6.5

Figure 6.4.1 Landslide Disasters in Cililin, Bandung District on, April 21, 2004

Banjir Bandang caused the collapse of a natural dam triggering floods and debris flows. In Wasior, Kabupaten Teluk Wondama, West Papua, 287 people were killed or missing and 80% of infrastructures were damaged by the Banjir Bandang that occurred in October 2010.

(2) Risk Assessment

Hazard maps on landslides of each of the 33 provinces were published by the CVGHM. The CVGHM has developed small-scale hazard maps on sediment disasters.

(3) Monitoring / Early Warning System

The CVGHM has conducted landslide observation using GPS, rainfall observation and extensometer, and has transferred the data to their office by telemeter systems.

Landslide warning based on rainfall forecast and landslide susceptibility maps are issued by the CVGHM. Since the correlation between rainfall and landslide occurrence has not been acceptably clarified, there is a need to develop an alert level according to scientific and concrete basis.

Three technical references, (1) “Guideline for Banjir Bandang Disaster Mitigation Management”, (2) “Manual for Researching Banjir Bandang Hazardous Area”, and (3) “Manual for Emergency Evacuation for Banjir Bandang”, were published in the technical cooperation project “Integrated Disaster Mitigation Management Project for Banjir Bandang” conducted by JICA from 2008 to 2012.

As some ASEAN countries do not have any guidelines or manuals on sediment disasters, it is considered that such guidelines and manuals are worth disseminating to other ASEAN countries.

(4) Problems facing Indonesia

ADPC pointed out that[68]:

- The number of settlements and pubic activity in medium and high susceptibility areas are still growing;
- Landslide Susceptibility Maps and the Early Warning System[69] are not being optimally used as a database for land-use planning and regional development based on geo-hazard thread; and
- Geo-hazard management is not formally a part of the early education curriculum in school

(5) Issues and Needs

Based on the above observations, the JICA Study Team considers the issues and needs as follows.

1) Issues

a) To upgrade the hazard maps in order for them to be used for such practical uses as planning of countermeasures, land-use, evacuation and so on;
b) To install early warning systems utilizing the existing landslide observation system in addition to the present warning practice based on rainfall ;
c) To develop an alert level based on scientific basis
d) To implement CBDRM to increase the awareness

In addition the Team considers it necessary:

e) To introduce effective countermeasures to mitigate landslides

2) Needs

a) To develop hazard maps of strategic priority areas that should be identified using the existing such information as the hazard maps
b) To install early updated warning systems to the strategic priority landslides, together with proposing reliable alert levels
c) To implement CBDRM to communities as necessary

68 http://www.adrc.asia/publications/TDRM2005/TDRM_Good_Practices/PDF/PDF-2008e/3.Indonesia.pdf
69 The Early Warning System means to provide potential landslide map prepared by overlaying landslide susceptibility maps and monthly rainfall forecasts; does not mean any warnings based on the monitoring the landslides themselves.

d) To conduct public awareness campaigns

In summary, it is considered necessary to implement “A Study on Comprehensive sediment disaster management plan in strategic priority areas”.

6.4.2 Lao PDR

(1) Present Situation of Sediment Disaster

Mountainous areas cover about 80% of the whole country of Lao PDR. Sediment disasters occur in mountainous areas as triggered by heavy rainfall or typhoons during the rainy seasons. Such have caused severe damage to human lives and infrastructure especially roads. In the northern region of Lao PDR, landslides and slope failures have occurred repeatedly due to typhoons. When typhoon Haima hit Lao PDR in 2011, large-scale slope failures of more than 300 m wide occurred along National Road 13 N, resulting in road closure and loss of human lives. The costs for recovery of National Road 13 N in 2011 was estimated at LAK 100 billion, and of all national and district roads throughout the country the same year was estimated at LAK 900 billion. As compared to the road maintenance budget of about LAK 300 billion of the Department of Road (DOR) for fiscal year 2011, the cost of recovery from road disaster has become an economic burden to Lao PDR.

(2) Risk Assessment

The organization specializing in sediment disaster does not exist in any governmental organization such as the DGM and DWR, therefore, sediment disaster information and technology for disaster prevention have not been accumulated, and impact assessment including producing a hazard map for sediment disaster has not been conducted either.

In order to anticipate sediment disaster damage along trunk roads and to plan disaster prevention measures, the JICA Study Team recommended the collection of disaster information throughout Lao PDR, and the development of a master plan to prioritize the route and area. Based on the priority order of the master plan, there is a need to conduct risk assessment including developing hazard maps of each route.

(3) Monitoring / Early Warning System

There is no activity regarding monitoring and early warning system for sediment disasters except for meteorological and hydrological observations by the DMH. The JICA Study Team recommended the development of a hazard map to identify susceptible areas to sediment disaster, and establishment of an observation system and early warning system.

(4) Preparedness / Prevention and Mitigation

Proactive countermeasures such as slope protection works and landslide countermeasures (drainage works and removal of unstable soil) are important issues in Lao PDR. Even though sediment disaster occurs frequently in Lao PDR, the technology needed for sediment disaster countermeasures remain undeveloped. Only urgent removal of fallen/collapsed sediments after such a disaster has been carried out. Permanent countermeasures such as slope protection works and/or landslide countermeasures have yet to be implemented. It was considered that post-disaster responses and increasing secondary damages contribute to the tightening of the road maintenance budget. The JICA Study Team considered that strengthening of the road maintenance system/mechanism, management of disaster records and development of knowledge and experience on disaster prevention in the DOR as the road administrative organization are important issues in the road sector of Lao PDR.

In the South East Asia Community Access Programme (SEACAP) supported by the UK, simple and reasonable countermeasures such as gabion walls and revetment works were constructed and a handbook about design and construction of countermeasures was formulated. However, the countermeasures are small-scale and simple enough that such cannot be adapted to large-scale landslides and slope failures. The MPWT hopes to improve on preventive technology against large-scale slope disaster in order to secure safe traffic.

(5) Emergency Response

Emergency response for sediment disasters along roads is administrated by the DOR under the MPWT and DPWT of each province. The DPWT agrees to unit price contracts with local contractors in advance of the rainy season. In case sediment disaster occurs, the contractors remove the fallen sediments and/or cuts on the mountainside using heavy machinery in order to re-open the road as soon as possible.

Detailed geological investigation is not conducted before construction. Since the scale, range and mechanism of sediment disasters have not been clarified, reasonable measures could not be applied to adequate areas. Moreover, leaving the slope unstable and unprepared responses have caused secondary damages and increased the road maintenance cost. The JICA Study Team suggested implementing emergency response based on a systematic procedure including planning permanent countermeasures.

(6) Issues and Needs

1) Issue[70]

   a) Improve road disaster management using structural and non-structural measures.

2) Needs[71]

   a) Development of road disaster prevention plans for economic corridors and capacity development on road maintenance and of the management sector.

6.4.3 Malaysia

(1) Present Situation of Sediment Disaster

Minerals and Geosciences Department (JMG) of Ministry of Natural Resources and Environment (NRE) pointed out that the following three areas are subject to problematic landslide disasters.

[70] All views were identified by the MPWT in the interview with the JICA Study Team.
[71] All views are attributed to the JICA Study Team.

- Kundasang (Kota Kinabalu) of Sabah district,
- Uluk Klang of Selangor district, and
- Cameron Highlands of Pahang district

Much information is not available on those landslides, but an outline of the landslide of Kota Kinabalu is that for the last 86 years (1924 – 2010) a total of 58 landslides occurred; sacrificing 118 people, destructing buildings, roads, cars, bridges, public facilities etc. To mitigate the landslides structural works were implemented with a cost of 50 billion RM (LARAM 2012; www.laram.unisa.it).

It was reported[72] that the government had commissioned the study in 206 following a spate of landslide in the Klang Valley notably in Buki Antarabangsa area; the study cheeked 583 slopes and for a detailed report a thorough study on the stability of the slopes needs to be done; the landslide claimed the lives of five people in December 2008, with 14 bungalows destroyed and hundreds of residents displaced. About 60% of the RM 300 million stadium's roof collapsed (June 2, 2008) only after a year of construction.

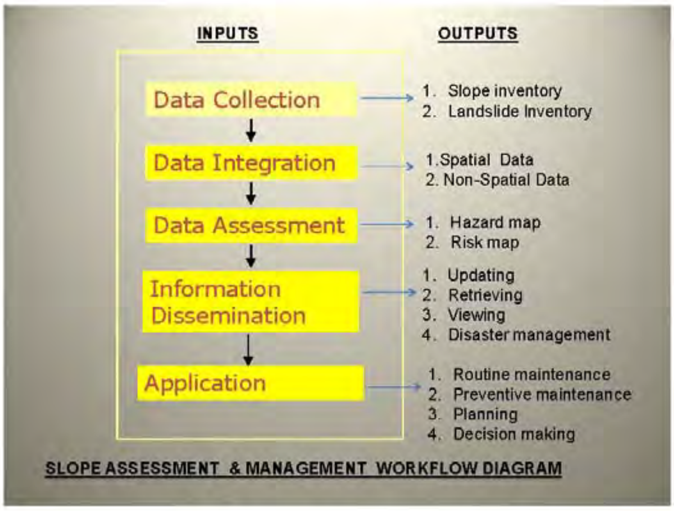
On August 8, 2011, a massive landslide occurred in an indigenous settlement near the Cameron Highland hill resort claiming 7 people, and dozens of families be evacuated[73]. The areas

(2) Risk Assessment

Since the study conducted in Klang Valley was preliminary, the JMG proposed that detail hazard map study should be conducted; such hazard map studies also have to be conducted in the other two landslide areas mentioned above. The Study Team considers that not only development of the hazard maps of the three nominated areas, comprehensive sediment disaster management plans that include basic investigations, countermeasure plan and monitoring and early warning plan; have to be conducted

On the other hand, JKR introduced a slope assessment and management System named Integrated Slope Information System (ISIS)[74]. An outline of the work flow of the system is as shown in Figure below.

[72] The star (December 20, 2009)
[73] The Huffington post visited on 15 Aug 2012
[74] The concept of the database was originally introduced by the JICA Study Team (2001). The JKR has upgraded and enhanced the concept and the system to better –suit to the increasing requirement.



Data source: JKR Presentation
Figure 6 4.2 Slope Assessment and Management Work Flow Diagram

JKR explained that presently, 20,000 slopes on Peninsular Malaysia (almost 90% completed) have been inventoried and classified their hazards and risk rankings. JKR also explained that they would make inventories of 3,000 slopes per year in Sarawak, 300 slopes per year in Sabah and 1,000 slopes per year in Peninsular Malaysia. However, landslide inventory has not been very promising and convincing. It is though technology/knowledge for landslide categorization are not developed enough.

(3) Monitoring / Early Warning System

Landslide prone areas should be installed with monitoring and early warning systems for evacuation; however, more research on the landslide prone areas should be conducted by relevant agencies. Based on such research results, priority areas should be selected for future installation of monitoring and warning systems.

(4) Issues and Needs

1) Issues

- To develop the hazard maps in strategic areas;
- To conduct comprehensive sediment disaster study in strategic areas;
- To install early warning systems in strategic areas;
- To introduce countermeasures in strategic areas;

2) Needs

Study on sediment disaster management plan in strategic priority areas in Kundasang (Kota Kinabalu) of Sabah district, Uluk Klang of Selangor district, and Cameron Highlands of Pahang district

6.4.4 Myanmar

(1) Present Situation of Sediment Disaster

Sediment disaster has rarely damaged houses and human beings in mountainous areas as such areas have low population. Sediment disasters such as landslide and slope failure have damaged the roads passing through mountainous areas in and around Rakhine State and Dawei in Tanintharyi Division.

(2) Risk Assessment

The MGS produced a small-scale sediment disaster hazard map of the entire country based on geological and topographical distribution. The MES and MGS have held workshops about landslides in some areas. Some researchers have conducted studies independently. Community-based risk assessment has not been conducted yet by any organization.

Since there is no governmental agency in charge of sediment disaster, disaster information and preventive technology have not been accumulated. The JICA Study Team considers that there is a need to develop a hazard map in order to anticipate sediment disaster damage on important trunk roads.

(3) Monitoring / Early Warning System

The DMH is the one responsible for issuing heavy rain warnings; however, it and other organizations do not conduct monitoring of sediment disasters. The JICA Study Team recommended the establishment of observation and early warning systems after hazard maps have been developed in order to identify first the landslide susceptible areas.

(4) Preparedness / Prevention and Mitigation

Sediment disaster prevention measures including structural and non-structural works have not been implemented at present. The JICA Study Team also recommended that monitoring and early warning systems need to be installed and structural measures need to be constructed in priority areas after risk assessment including hazard mapping has been done throughout Myanmar.

(5) Emergency Response

Preparedness for emergency response to sediment disasters has not conducted. Presently, rescue and relief operations of affected people are the major response to disaster activities.

(6) Issues and Needs

1) Issues[75]

a) Presently no governmental agency in charge of sediment disaster is available
b) Priority areas for further study have to selected based on the existing small scale hazard maps and other existing information

[75] All the views are attributed to the JICA Study Team.

c) Detailed studies have to be implemented in the priority areas including trunk roads in mountainous areas

d) Countermeasures and monitoring and early warning have to be implemented in the priority areas as necessary

e) CBDRM has not been implemented

2) Needs[75]

Study on sediment disaster management in mountainous areas including CBDRM

6.4.5 Philippines

(1) Present Situation of Sediment Disaster

Sediment disaster induced by rainfall or earthquake have often adversely affected human lives, houses and infrastructure as weak and erosible volcanic rock and soil are distributed in the mountainous areas of the Philippines. In 2006, large-scale landslides triggered by long lasting rainfall occurred in the mountainous area of Southern Leyte Province in Leyte Island; killing 1,126 people. Sediment disasters along roads account to more than 90% of the number of sediment disasters in the Philippines. Various scales of road sediment disasters have damaged the transportation network in the country. The target facilities or areas which need to be prevented from sediment disaster are mainly the trunk roads and densely-populated places in mountainous areas.

Table 6.4.1 shows the history of major sediment disasters in the Philippines.

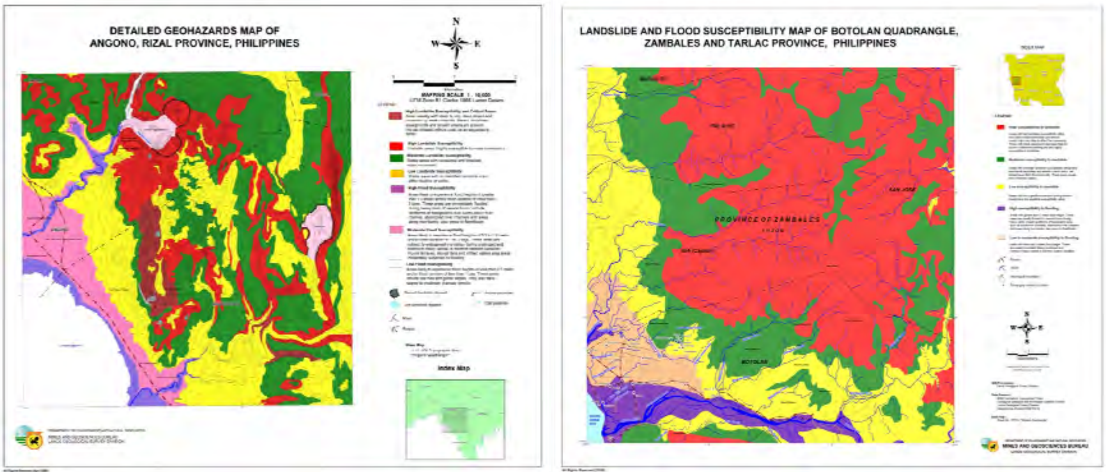
Table 6.4.1 History of Major Sediment Disasters in Philippines

Date	Location	Comment
2003/12/19	Central Philippines	About 200 people may have died in central Philippines, in two landslides triggered by six days of heavy rains in the Philippines.
2006/2/14	Municipality of Sogod, Southern Leyte	Continuous monsoon rain caused death and destruction in the Philippines. A landslide in Agos in the municipality of Sogod Southern Leyte killed 11 and injured 25. Two more people were missing. Homes and crops were also destroyed or damaged.
2006/9/22	Northern Philippines	At least eight people were killed and 14 were injured when a landslide slammed into a narrow mountain road in northern Philippines, local disaster officials said on September 22.
2007/1/3	Burgy Diit de Suba, Silvino Lobos, Nothern Samar	A landslide occurred in Burgy Diit de Suba, Silvino Lobos, Nothern Samar which buried a house. Five were confirmed dead, three injured and one missing.
2007/8/9	Northern Philippines	Tropical Storm Pabuk churned across the Philippines on a Wednesday, triggering deadly landslides
2008/9/8	Masara, Municipality of Maco, Compostela Valley Province	Two landslides occurred at Poblacion Masara, Municipality of Maco, Compostela Valley Province due to heavy rains. Nine persons were reported dead, 24 injured and 14 still missing.
2008/12/27	Compostela Valley Province	Heavy rainfalls caused three landslides in Compostela Valley Province, 202 families, and 960 persons were affected.
2009/5/19	Southern Philippines	The death toll in a landslide that struck a mining village in the southern Philippines hit 26 as rescuers dug up more bodies overnight, officials said Tuesday (19/05/2009) - DPA
2010/1/5	Valencia, Cagdianao, Province of Dinagat Islands	925 people affected by landslide due to continuous rains in Valencia, Cagdianao, Province of Dinagat Islands.

Source: (1) Asian Disaster Reduction Centre (ADRC), GLobal IDEntifier Number (GLIDE) http://www.glidenumber.net/glide/public/search/search.jsp,

(2) Risk Assessment

The Mines and Geosciences Bureau (MGB) has conducted geomorphic analysis and site reconnaissance, and created about 750 sheets of sediment disaster hazard maps with scales of 1:50,000 and 1:10,000 in the READY Project supported by UNDP and AusAID (see Figure 6.4.2). The hazard maps are available for browsing and download in the MGB's website (http://www.mgb.gov.ph/). The MGB issued danger advisories to barangays just after the site reconnaissance in the READY Project before providing the hazard maps to the local governments.



1:10,000 Scale Detailed Geohazard Map 1:50,000 Scale Landslide Susceptibility Map

Source: MGB, *The National Geohazards Mapping and Assessment* (PPT, 30, 32)

Figure 6.4.3 Sediment Disaster Hazard Maps

The hazard maps were mainly created with a scale of 1:50,000 by the MGB. These maps neither show the types or classifications of sediment hazards nor the exact occurrence locations of hazards. Hence, such maps were not utilized to develop practical disaster prevention measures such as evacuation, land use and countermeasure plans. According to the MGB, in order to create a more detailed or more specific hazard map, large-scale base maps of more than 1:10,000 scales need to be produced. Also, the JICA Study Team recommended capacity development of MGB technical staff for them to be able to identify disaster types and clarify disaster mechanisms.

In the provinces near Metro Manila such as Rizal, Bulacan, and Cavite, the residential areas of poverty-stricken people has been expanding to sloping areas. In some cases, they construct their settlements by cutting the slope, rendering such areas more susceptible to collapse. In densely populated sloping areas, accurate hazard maps as well as vulnerability maps need to be developed. The JICA Study Team recommended that regional disaster prevention plans based on risk assessment need to be developed, including structural works, monitoring, forecasting and early warning, CBDRM promotion, removal of illegal occupants, etc.

(3) Monitoring / Early Warning System

Monitoring and observation of sediment disasters have not been conducted. The JICA Study Team considered that there is a need to implement monitoring activities appropriate to the disaster type such as landslide, debris flow, slope failure, etc. Also, monitoring should be started in prioritized sites, such as those with important facilities or infrastructure, and/or having dense population around the main cities. Thereafter, early warning systems and evacuation plans need to be developed.

(4) Preparedness / Prevention and Mitigation

Based on the hazard maps created in the READY Project, the MGB has conducted public awareness activities in each community by holding workshops on sediment disaster and setting up signboards to identify the susceptible areas. In the JICA technical cooperation project “Improvement of Quality Management for Highway and Bridge Construction and Maintenance” in 2006, structural and non-structural measures for road slope stabilization were introduced to the DPWH. The response to sediment disasters except for roads is limited to the removal of fallen sediments after disaster, and evacuation and relocation of residents.

Although there are simple structural measures that were considered to reduce risks in some cases, such have not been implemented. The JICA Study Team considered that there is a need to promote structural measures, such as drainage works and gabion walls, which can be carried out by CBDRM.

(5) Emergency Response

The current major activities on emergency response are “search and rescue” after a disaster occurs. The MGB has conducted an urgent survey as an emergency response. The JICA Study Team considered that there is a need to conduct not only urgent surveys but also geotechnical analysis and monitoring in order to design permanent countermeasures for prevention of secondary disasters. Urgent observation systems, unmanned construction and emergency measures need to be introduced. It is also necessary to develop the technical capacity of the OCD, MGB and LGU.

(6) Issues and Needs

1) Issues[76]

a) To identify prioritized sediment disaster prone areas such as densely-populated areas, trunk roads and etc
b) To improve and upgrade the geo-hazard maps the prioritized areas
c) To install monitoring, early warning systems in prioritized areas
d) To develop the disaster prevention plan for local community
e) To conduct proper geotechnical analysis and monitoring even for the case of emergency as necessary

[76] All the views are identified by MGB in the interview with the JICA Study Team.

2) Needs

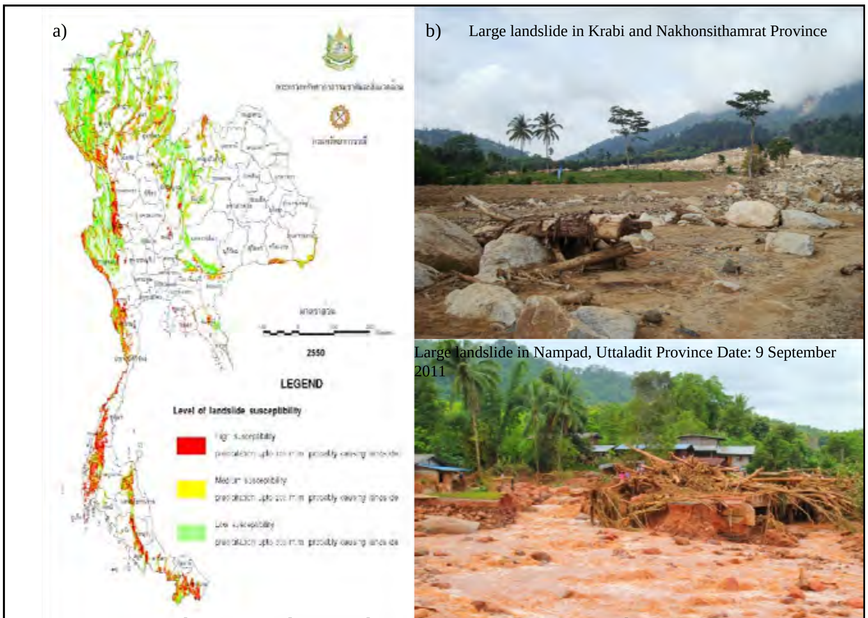
Study on the comprehensive sediment disaster management plan

6.4.6 Thailand

(1) Present Situation of Sediment Disaster

Sediment disasters have occurred frequently in mountainous areas in northern and western Thailand. Especially, damages caused by debris flow disasters to villages were severe. In 2011, large-scale debris flow occurred in Nakhonsithamrat Prefecture and Krabi Prefecture which killed 14 people and resulted to damages amounting THB 10 billion (refer to Figure 6.4.3).

Sediment disaster susceptibility areas cover 6,450 villages in 51 prefectures of Thailand



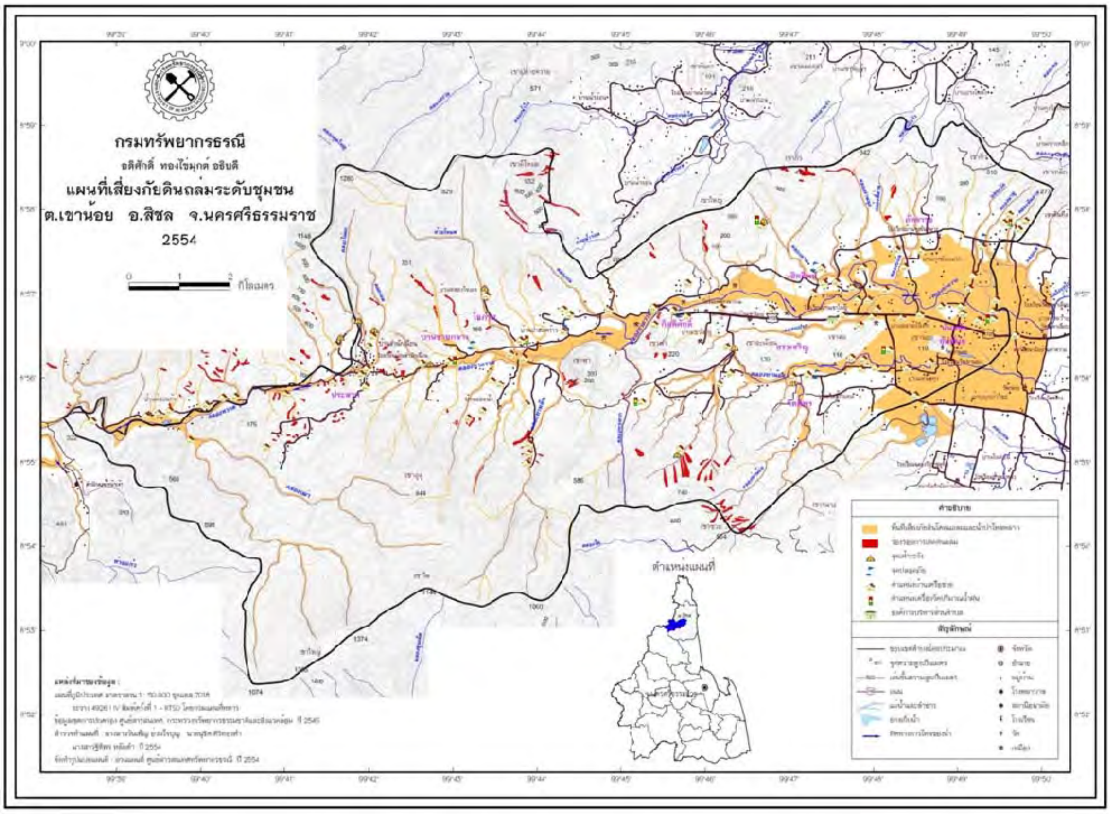
Source: DMR, The DMR Role in Geohazards Mitigation (PPT, a)5, b)3-4)

Figure 6.4.4 a) Landslide Hazard Map, b) Photographs of Sediment Disaster

(2) Risk Assessment

The DMR has conducted geomorphic analysis using satellite photographs, and they have developed sediment disaster hazard maps from base maps of 1:10,000 scales which were an enlargement of original topographic maps of 1:50,000 scale. The maps of 70 sites have been completed, and maps of 190 other sites are planned to be produced in 2012. The hazard maps of many sites still remain to be created. Figure 6.4.4 shows a sample of a sediment disaster hazard map created by the DMR.

With the development of hazard maps and public awareness, the JICA Study Team considered that there is a need to limit activities, such as rock and soil excavation, deforestation, and building of new houses, in vulnerable areas.



Source: DMR, The aggressive operation against landslide (PPT, 6)

Figure 6.4.5 Landslide Hazard Map Created in 2011

Source: DMR, *The aggressive operation against landslide* (PPT, 5)

Figure 6.4.6
Simple Rain Gauge

(3) Monitoring / Early Warning System

The TMD observes the river water level and rainfall, and is responsible for issuing warnings based on meteorological and hydrological data. The DMR conducts urgent surveys of debris flow in mountain streams when the local government requests to do so. The DMR gives advice on monitoring and observation as described below. Some communities have conducted rainfall observation using a simple rain gauge (see Figure 6.4.5), and visual monitoring of river level. The DMR has promoted the development of an information network between upstream and downstream areas so that warnings can be relayed between the two areas in case of emergency. Monitoring and observation activities have been conducted by volunteers from the communities. The JICA Study Team recommended that the contents and accuracy of monitoring and observation should be improved. The alert level of rainfall and river level have been determined with nationwide uniformity, but its scientific background is unclear. The alert level must be set based on scientific and technical background.

Disaster prevention awareness for sediment disaster of communities in mountainous areas is so high that the evacuation and rescue drills have been conducted by an independent group composed of volunteers from the communities. On the other hand, it is difficult to properly identify and forecast the occurrence of sediment disasters using the current observation system which only makes use of simple rain gauges and river level observation by the communities. The JICA Study Team recommended that automatic rain gauges and sensors detecting debris flow should be introduced to strengthen the monitoring system. The JICA Study Team considered that the alert level has to be established based on correlation between disaster occurrence and rainfall intensity, and to progress the development of countermeasures and early warning systems.

(4) Preparedness / Prevention and Mitigation

Structural measures against sediment disasters have been carried out by the local governments and the road authority. These include retaining walls on the road slope made of gabions, and check dams (sabo dams) in streams (see Figure 6.4.6). However, such countermeasures are limited to small-scale disasters. Advanced countermeasures such as ground anchor works and/or rock volt works, which require application of higher technology, have not been introduced yet. The JICA Study Team considered that the introduction of these advanced countermeasures is an issue for sediment disaster management in Thailand.

Gabion Wall Check Dam

Source: DMR, *The DMR Role in Geohazards Mitigation* (PPT, 15)

Figure 6.4.7 Countermeasures against Landslide

The structural measures against sediment disasters have not been constructed systematically and remain at small-scale and simple levels. The JICA Study Team considered that, on the basis of a disaster prevention plan, structural works in the areas with important facilities or infrastructure need to be implemented. Combining structural works and non-structural works is also effective to prevent sediment disasters in advance thus reducing damage.

(5) Emergency Response

The DDPM is the leading agency for preparing emergency responses as wells as directing other agencies in case of disaster. In communities of mountainous areas, the DPPM has conducted evacuation and rescue drills in collaboration with the DMR, local governments, schools, hospitals, etc.

(6) Issues and Needs

1) Issues[77]

a) To improve the monitoring system and introduce the advanced technology for detecting debris flow, and also
b) To introduce the advanced countermeasures for streams that posed the danger of mud and debris flow and residential area.

2) Needs[78]

a) Study on development of sediment disaster monitoring and effective utilization of SABO technology.

6.4.7 Vietnam

(1) Present situations

"Development of landslide risk assessment technology and education in Vietnam and other areas in the Greater Mekong Sub-region" is being carried out in the SATREPS project. The project is described below[79]:

Mountainous regions in the Greater Mekong Subregion (GMS), which include Vietnam, Laos, and Myanmar, have suffered from landslide disasters due to the combination of weak ground, strong rainfall in the rainy season, and strong tropical weathering. The arterial roads connecting the northern and southern parts of Vietnam and habitants in mountain villages are particularly in danger, making it necessary to develop technologies for ensuring their safety. This study will be led by Japanese research organizations, mainly the International Consortium on Landslides (ICL), in collaboration with the Institute of Transport Science and Technology (ITST) of Vietnam to develop a technology for landslide risk assessment and to build a technology and system for reducing landslides, which will include early warning, land use, and capacity development, for slopes along the arterial roads in Central Vietnam and around the communities in mountainous regions. The study will also build a network for landslide research and contribute to capacity development for the mountainous regions in the GMS.

(2) Issues and Needs

Although no specific issues and needs have been collected through the interview survey with the organization the JICA Study Team visited, the JICA Study Team would like to point out

[77] All views were identified by the DMR in the interview with the JICA Study Team.
[78] All views are attributed to the JICA Study Team.
[79] SATREPS HP (http://www.jst.go.jp/global/english/kadai/index.html)

the following general issues and needs taking into consideration general understandings in ASEAN countries.

1) Issues

a) To conduct general risk assessment (hazard map) for whole country to identify prioritized areas
b) To conduct detail studies in prioritized areas including planning of countermeasures; monitoring and early warning systems
c) To implement countermeasures and install monitoring and early warning systems
d) To conduct CBDRM

2) Needs

Study on basic sediment disaster management plan