DATA COLLECTION SURVEY
ON
ASEAN REGIONAL COLLABORATION
IN
DISASTER MANAGEMENT

FINAL REPORT
COUNTRY REPORT
THAILAND

DECEMBER 2012

JAPAN INTERNATIONAL COOPERATION AGENCY

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

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List of Abbreviations and Acronyms

A

AADMER	:	ASEAN Agreement on Disaster Management and Emergency Response
AAL	:	Average Annual Loss
ACDM	:	ASEAN Committee for Disaster Management
ADMIS	:	ASEAN Disaster Management Information System
AEIC	:	ASEAN Earthquake Information Center
AHA Center	:	ASEAN Coordination Center for Humanitarian Assistance on Disaster Management
ASEAN	:	Association of South East Asian Nations

B

BCP	:	Business Continuity Plan
BMA	:	Bangkok Metropolitan Administration
BMA	:	Bangkok Metropolitan Area
BMKG	:	Badan Meteorologi, Klimatologi, dan Geofisika (Meteorological, Climatological and Geophysical Agency)
BPBD	:	Badan Penanggulangan Bencana Daerah (Regional Disaster Management Agency)

C

CBDRM	:	Community-Based Disaster Risk Management
CCFSC	:	Central Committee for Flood and Storm Control
CCTV	:	Closed Circuit Television
CRED	:	Center for Research on the Epidemiology of Disasters
CVGHM	:	Centre for Volcanology and Geological Hazard Mitigation

D

DDMFSC	:	Department of Dyke Management, Flood and Storm Control
DDMRC	:	District Disaster Management and Relief Committee
DDPM	:	Department of Disaster Prevention and Mitigation
DID	:	Department of Irrigation and Drainage
DKI	:	Daerah Khusus Ibukota (Special Capital Territory)
DMH	:	Department of Meteorology and Hydrology
DMIS	:	Disaster Management Information System
DMR	:	Department of Mineral Resources
DRR	:	Disaster Risk Reduction
DWR	:	Department of Water Resources

E, F

EGAT	:	Electricity Generation Authority of Thailand
EM-DAT	:	Emergency Disaster Database
EOP	:	Emergency Operating Procedures
EOS	:	Emergency Operating System
EWS	:	Early Warning System
FCC	:	Flood Control Center

G

GDP	:	Gross Domestic Product
GLIDE	:	GLobal IDEntifier Number
GPS	:	Global Positioning System

GTS	:	Global Telecommunication System
H		
HAII	:	Hydro and Agro Informatic Institute
HFA	:	Hyogo Framework for Actions
I		
ICHARM	:	International Centre for Water Hazard and Risk Management
I-DRMP	:	Integrated Disaster Risk Management Plan
InaTEWS	:	Indonesia Tsunami Early Warning System
INGO	:	International Non-government Organisation
IOTWS	:	Indian Ocean Tsunami Warning and Mitigation System
J		
JICA	:	Japan International Cooperation Agency
JMA	:	Japan Meteorological Agency
JMG	:	Minerals and Geoscience Department Malaysia
L		
Lao PDR	:	Lao People's Democratic Republic
LIPI	:	National Institute of Science
M		
MES	:	Myanmar Engineering Society
MGB	:	Mines and Geosciences Bureau
MGS	:	Myanmar Geosciences Society
MMDA	:	Metro Manila Development Authority
MPWT	:	Ministry of Public Works and Transportation
N		
NDMC	:	National Disaster Management Center
NDMC	:	National Disaster Management Committee
NDPMC	:	National Disaster Prevention and Mitigation Committee
NDPMP	:	National Disaster Prevention and Mitigation Plan
NDWC	:	National Disaster Warning Center
NFP	:	National Focal Point
NGO	:	Non-governmental Organization
O, P		
OFDA	:	Office of Foreign Disaster Assistance
PHIVOLCS	:	Philippine Institute of Volcanology and Seismology
PPT	:	PowerPoint
PTWC	:	Pacific Tsunami Warning Center
R		
REDAS	:	Rapid Earthquake Damage Assessment System
RID	:	Royal Irrigation Department
RIMES	:	Regional Integrated Multi-Hazard Early Warning System
RSM	:	Regional Spectral Model
RTN	:	Royal Thai Navy
S		
SATREPS	:	Science and Technology Research Partnership for Sustainable Development
SEZ	:	Special Economic Zone
SMS	:	Short Message Service
SNAP	:	Strategic National Action Plan

SNS	:	Social Networking Service
SOP	:	Standard Operating Procedure
T~		
TMD	:	Thai Meteorological Department
UN	:	United Nation
USGS	:	United States Geological Survey
WMO	:	World Meteorological Organization
YCDC	:	Yangon City Development Committee

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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Abbreviation

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CHAPTER 1 INTRODUCTION

1.1 Background of the Survey

Frequency of natural disasters has been increasing for last 30 years in the world, having caused great damages/losses. Among those damages/losses, about 90 % are concentrated in the Asian region where natural disasters are one of the serious issues not only for humanitarian but also for economic and industrial point of view.

1.2 AADMER, HFA and AADMER Work Program

Under such circumstance, the ASEAN 10 countries had reached an agreement of "the ASEAN Agreement on Disaster Management and Emergency Response (AADMER)" on 26th July, 2005 (ratified on 24th December, 2009); 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 those activities above, the ASEAN Committee for Disaster Management (ACDM) adopted "AADMER Work Program 2010-2015" as the guideline of the activities for the AADMER, at its 15th Meeting of 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.

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

1.4 Cooperation between ASEAN and Japan

On the other hand, it was re-affirmed that Japan and the ASEAN would continue the mutual cooperation in the field of disaster management, at the Special Japan-ASEAN Ministerial Meeting in Jakarta on April 9, 2011 held soon after the Great East Japan Great Earthquake; at the ASEAN Post Ministerial Conference of July 21, 2011; and 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 to the Centre but also through bi-lateral cooperation with each ASEAN country for the regional natural disaster management.

1.5 Data Collection Survey

The activities of the AHA Centre have just started and therefore they do not have much information even fundamental on natural disasters and disaster management of the ASEAN countries.

Japan International Cooperation Agency (JICA) has therefore decided to conduct "the Data Collection Survey on ASEAN Regional Collaboration in Disaster Management" for considerations of future plans of assistances 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 the ASEAN counties;
- To conduct needs and potential assessment for 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 assistances for disaster management;
    - Bi-lateral assistance;
    - Regional assistance;
- ASEAN guideline/reference for flood risk assessment.

This report presents the country report of Thailand. The full reports for the study were prepared separately as Main Report.

CHAPTER 2 HAZARD PROFILE

2.1 Introduction

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

The ASEAN region is geographically diverse and includes high hills and 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 and Ayeyarwady River, and major water bodies as the Tonle Sap and Lake Tobe. There are several tectonic plates in the region that have cause earthquakes, volcanic eruptions and tsunamis; also locate the two great oceans of the Pacific and the Indians that are origins of seasonal typhoons or cyclones and tsunami. All these natural set-up are the background of a history of devastating disasters of various types that have caused economic and human losses across the regions.

Hereafter Chapter 2 describes an overview of disasters 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 this chapter are shown in Chapter 2.4.

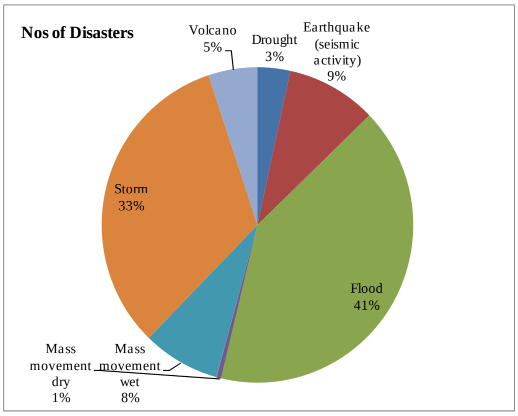
The Team notes that there are such issues in EM-DAT to be improved/ clarified that definitions of some hazards including multi-hazard are unclear, disasters of small scales are not, so on. However, this data base is considered useful when outlines of disasters among different states are compared on a 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.

[1] Among the 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

Number of Natural Disasters:

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)

Total Number of Affected People:

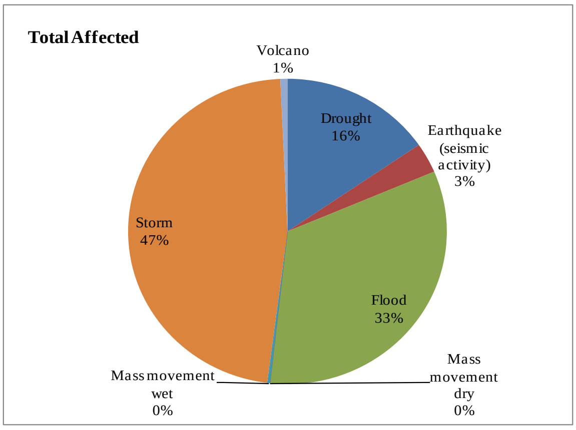
Figure 2.2.2 shows the total number of affected people. About 47% of the total number of people was affected due to 'storm' followed by 'flood' (33%). Water related hazards totaled to 80% and have significant impact on the people in the ASEAN region (Figure 2.2.2 above). On the other hand, 'drought' 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.

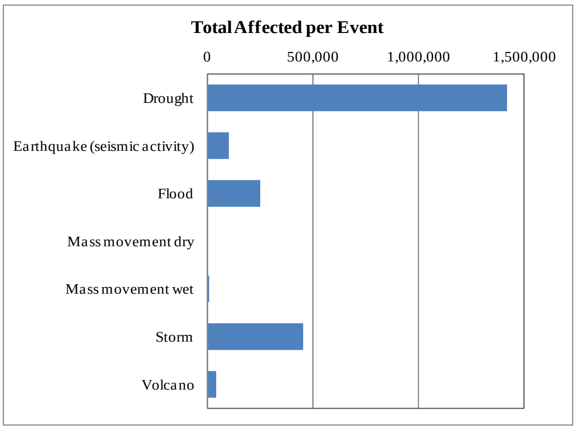
Total Number of Deaths:

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.

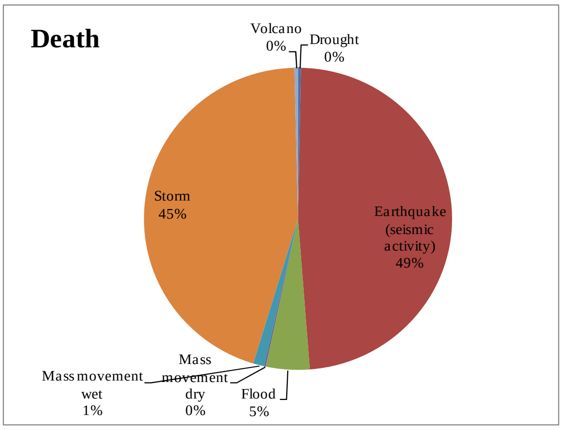


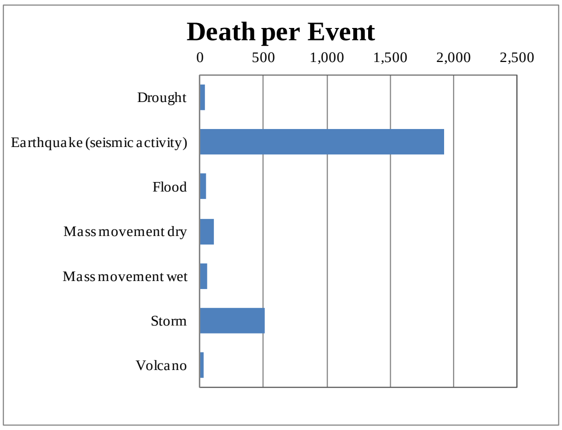


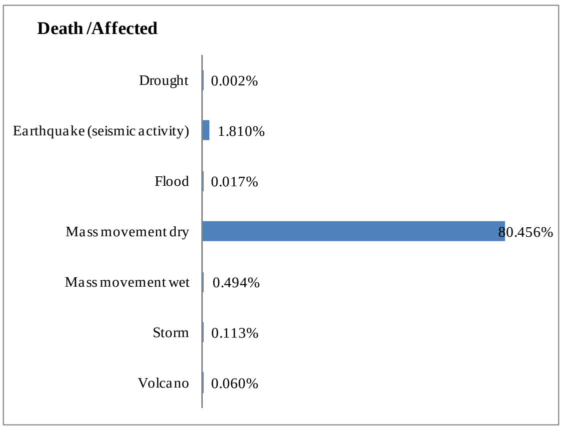
Total Affected	Total Affected	%	Nos of Disasters	Total Affected per event
Drought	51,030,144	15.4%	36	1,417,504
Earthquake (seismic activity)	10,526,945	3.2%	99	106,333
Flood	109,697,680	33.1%	433	253,343
Mass movement dry	701	0.0%	5	140
Mass movement wet	939,325	0.3%	85	11,051
Storm	156,402,854	47.3%	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)







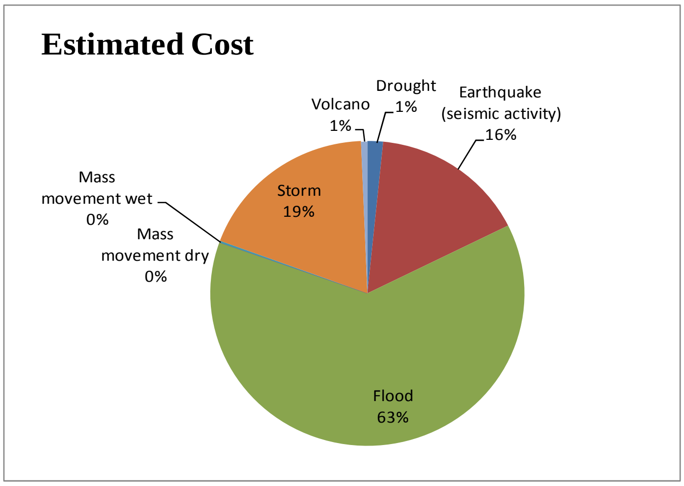
Death	Death	%	Nos of Disasters	Death per event	Death /Affected
Drought	1,274	0.3%	36	35	0.002%
Earthquake (seismic activity)	190,489	48.4%	99	1,924	1.810%
Flood	18,115	4.6%	433	42	0.017%
Mass movement dry	564	0.1%	5	113	80.456%
Mass movement wet	4,643	1.2%	85	55	0.494%
Storm	176,706	44.9%	344	514	0.113%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

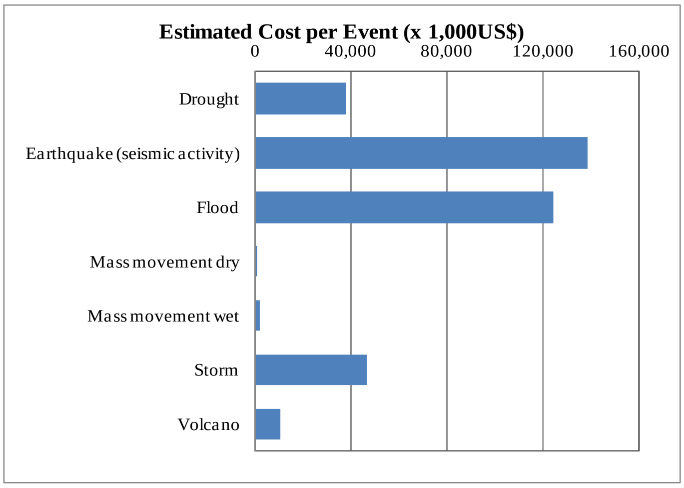
Data from 1980 to 2011
Data Source: "EM-DAT: The OFDA/CRED International Disaster Database
www.emdat.be - Université Catholique de Louvain - Brussels - Belgium"
Presentation: JICA Study Team (2012)

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

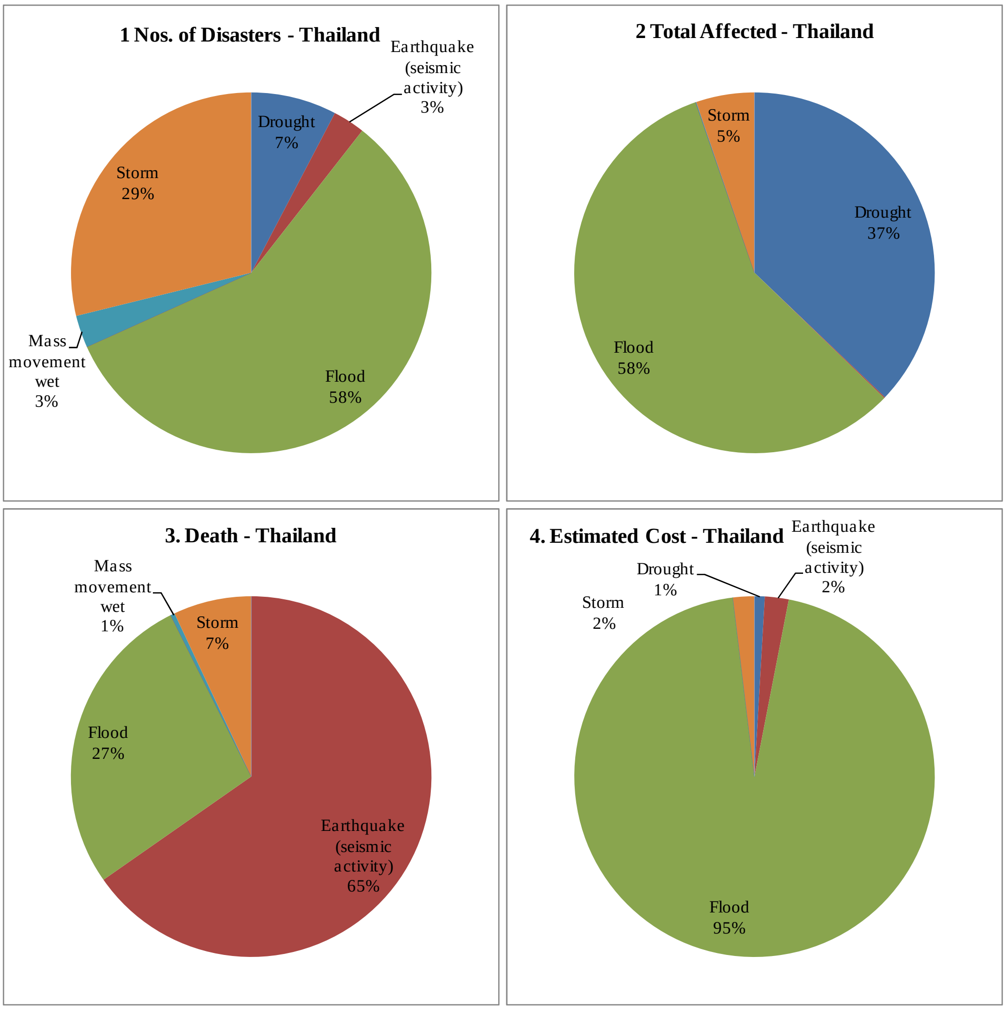
Data from 1980 to 2011
Data Source: "EM-DAT: The OFDA/CRED International Disaster Database www.emdat.be - Université Catholique de Louvain - Brussels - Belgium"
Presentation: JICA Study Team (2012)

(x 1,000US$)

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

2.3 Outline of Natural Disasters

Figure 2.3.1 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.



	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 2.3.1 Outline of Natural Disasters in Thailand

2.4 Appendix 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 2.4.1 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 2.4.2 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 2.4.3 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 2.4.4 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

CHAPTER 3 ORGANIZATION AND INSTITUTION

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

3.2 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.

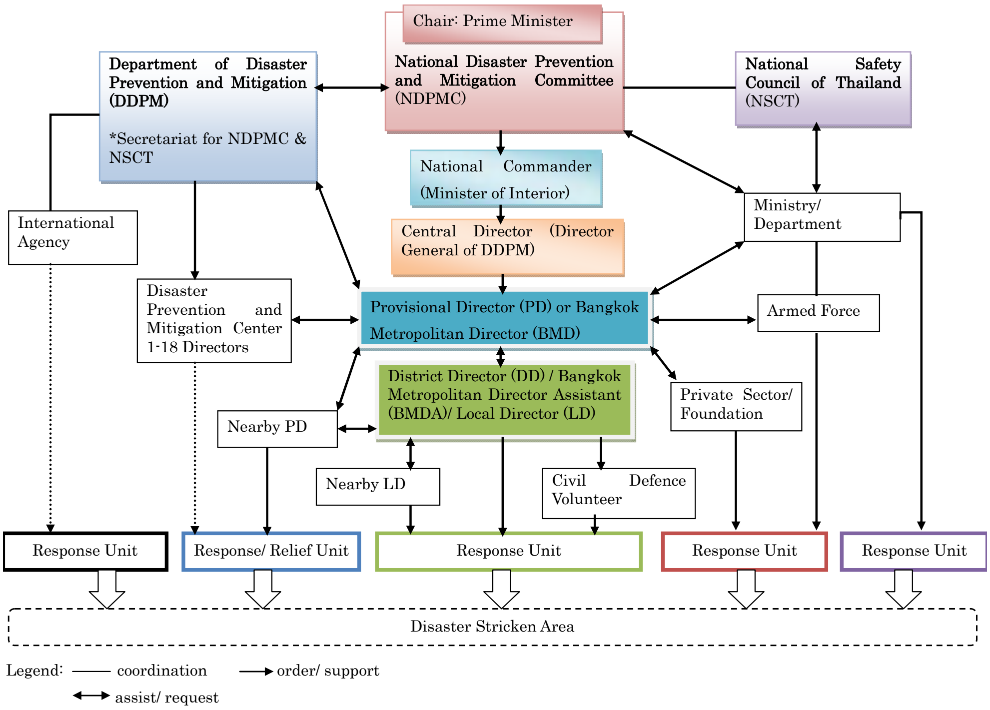
Budget is decentralized since 2002. Each local administration has authority over the use of funds.

3.3 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 3.3.1 Thailand's Disaster Management Structure

3.4 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.

3.5 Issues and Needs Concerning Organization and Institution

(1) Issues[1]

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[2]

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

[1] 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.

[2] 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.

CHAPTER 4 PRESENT SITUATION OF DISASTER MANAGEMENT AGAINST PREVAILING NATURAL DISASTERS IN THAILAND

4.1 Flood

(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 4.1.1 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.

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 4.1.1

Source: DWR

Figure 4.1.1 Flood map

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.

Nakornsawan Province ***Industrial zone of Ayutthaya Province*** ***Bangkok***

Source: DDPM Ministry of Interior

Figure 4.1.2 Flood Situation in 2011

Source: JICA Study Team

Figure 4.1.3 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 4.1.2). 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 4.1.2 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[1].

(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 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 2400 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

[1] The view is attributed to the JICA Study Team.

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.[2]

The other issues[3] 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:[4]

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 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), 1444 minor drainage canals (1686 km long), 369 pumping stations, and gates with a total pumping rate of 1531 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

[2] The view is identified by TMD (NDWC) in the interview with the JICA Study Team.
[3] The view is attributed to the JICA Study Team.
[4] The view is attributed to the JICA Study Team.

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 x 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,[5]
- Introduction of a single command system for water management,[6]
- Formulation of risk management of large-scale and extensive floods, including systematic countermeasures before, during, and after flooding [7]
- Integrated flood control and drainage plan for Bangkok, SEZ and supply chain, and[8]
- Promotion of flood control for the public understands.[9]

(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

[5] The view is identified by DWR in the interview with the JICA Study Team.
[6] The view is identified by DWR and DDPM in the interview with the JICA Study Team.
[7] The view is identified by DWR in the interview with the JICA Study Team.
[8] The view is identified by DWR in the interview with the JICA Study Team
[9] The view is identified by DWR in the interview with the JICA Study Team.

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:[10]

- 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.

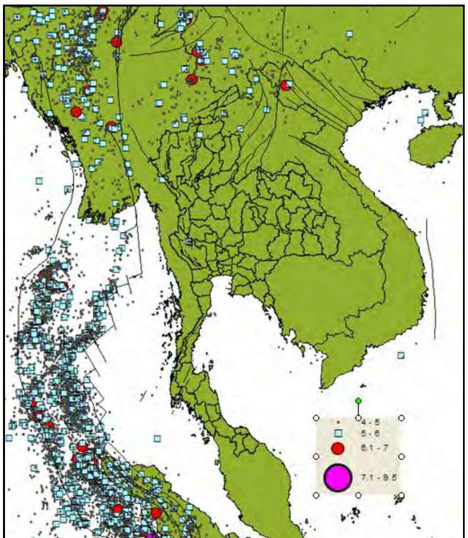
Furthermore to the formulation/establishment of such a disaster management plan, the efforts needed are as follows:[11]

- 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.

4.2 Earthquake and Tsunami

(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.



Source: TMD, *National Earthquake Monitoring for Tsunami Early Warning*, (PPT, 3)

Figure 4.2.1
Epicentre Distribution Map

[10] The view is identified by DWR in the interview with the JICA Study Team.
[11] The view is attributed to the JICA Study Team.

Table 4.2.1 shows the recorded earthquakes with magnitudes of more than 5.0. Figure 4.2.1 shows the distribution of epicenters in and around Thailand.

Table 4.2.1 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

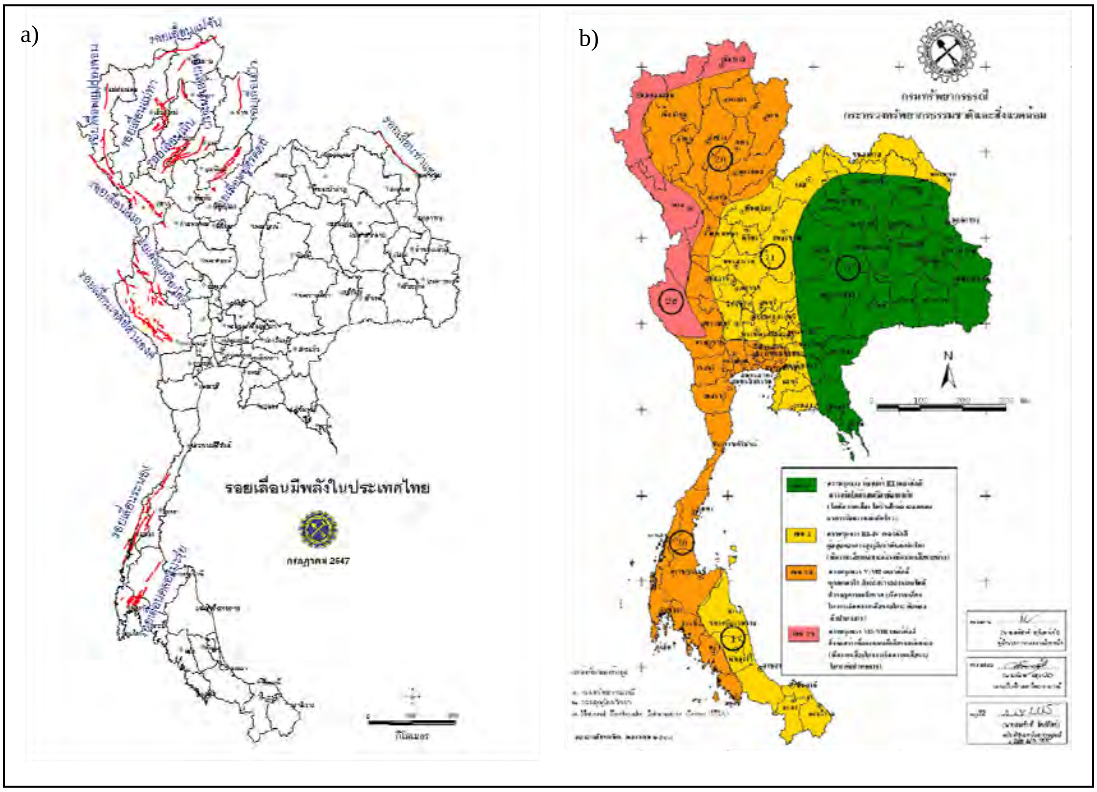
Source: DMR, *Earthquake, tsunami in Thailand.*(PPT, 25)

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 4.2.2 a), and also an earthquake risk map which assessed risk in four levels (Figure 4.2.2 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 4.2.2 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 4.2.3), 15 seismographs manufactured in Canada (Phase-1 from 2006), and 26 seismographs manufactured in Australia (Phase-2 from 2009).

• 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

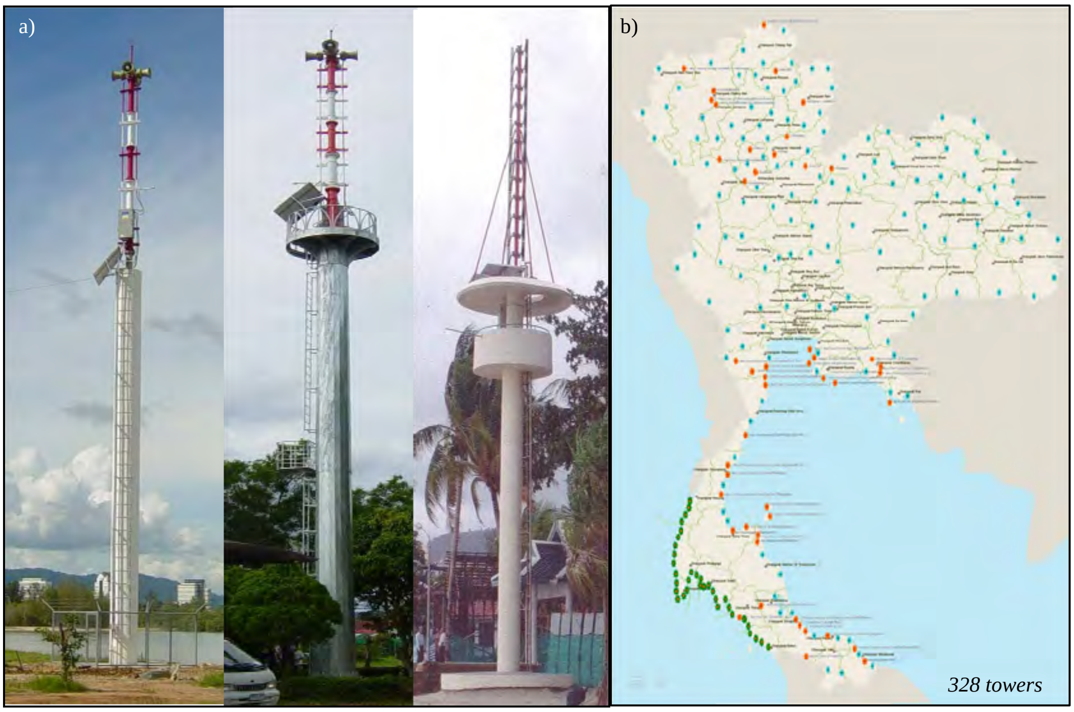
Source: TMD
(http://www.seismology.tmd.go.th/en/stations.php)

Figure 4.2.3
Seismic Observation Location Map

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 4.2.4 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 4.2.4). 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[12]

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[13]

a) Study on the development of an earthquake monitoring system and a disaster prevention plan.

[12] All views were identified by the TMD in the interview with the JICA Study Team.
[13] All views are attributed to the JICA Study Team.

4.3 Volcano

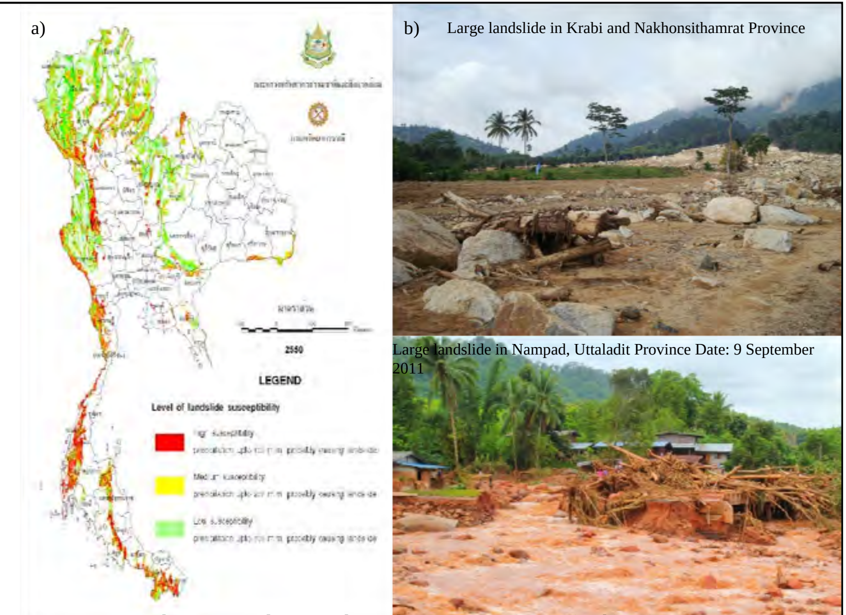
There is not volcano in Thailand.

4.4 Sediment Disaster

(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 4.4.1).

Sediment disaster susceptibility areas cover 6,450 villages in 51 prefectures of Thailand



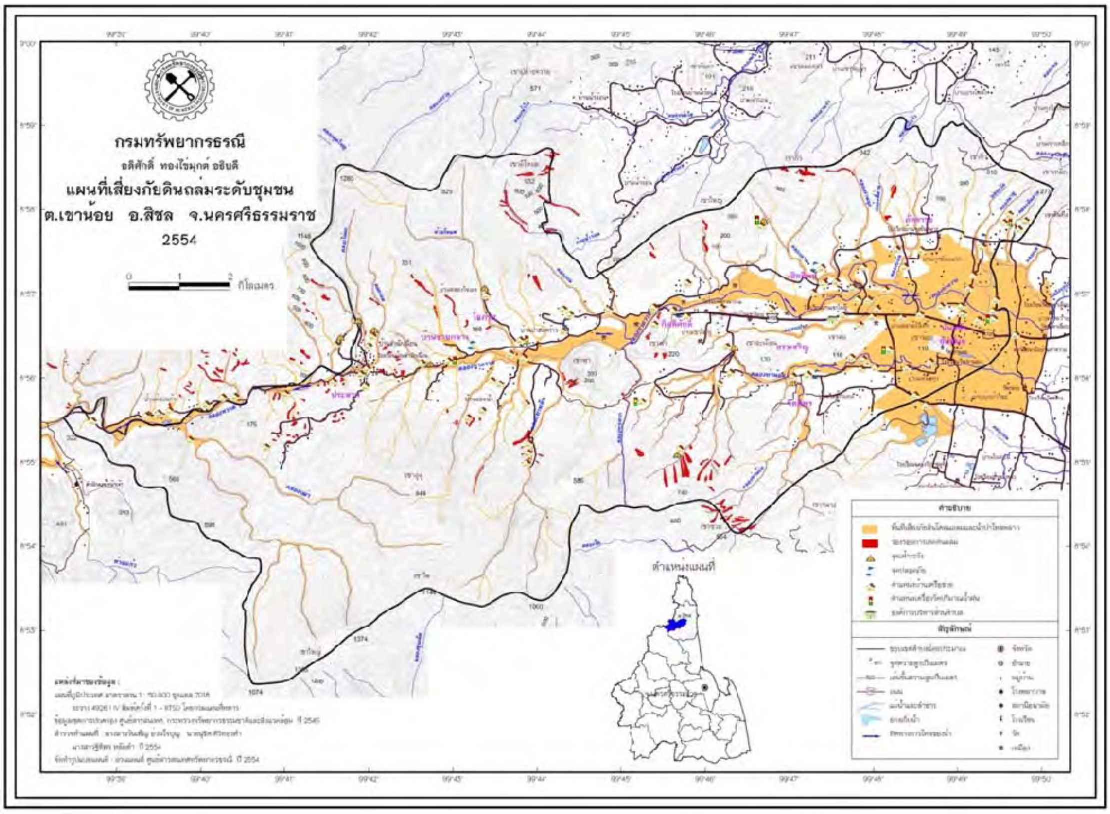
Source: DMR, The DMR Role in Geohazards Mitigation (PPT, a)5, b)3-4)

Figure 4.4.1 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 4.4.2 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 4.4.2 Landslide Hazard Map Created in 2011

(3) Monitoring / Early Warning System

Source: DMR, *The aggressive operation against landslide* (PPT, 5)

Figure 4.4.3
Simple Rain Gauge

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 4.4.3), 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 4.4.4). 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 4.4.4 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 DDPM has conducted evacuation and rescue drills in collaboration with the DMR, local governments, schools, hospitals, etc.

(6) Issues and Needs

1) Issues[14]

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[15]

a) Study on development of sediment disaster monitoring and effective utilization of SABO technology.

[14] All views were identified by the DMR in the interview with the JICA Study Team.
[15] All views are attributed to the JICA Study Team.

CHAPTER 5 DISASTER MANAGEMENT INFORMATION, EARLY WARNING AND DISASTER EDUCATION

The HFA-3 mentions that stakeholders need to use knowledge, innovation and education to build a culture of safety and resilience at all levels. In order to achieve that, it is important to collect and integrate various types of information on disaster management to be able to share, and freely use it.

In this chapter, the JICA Study Team organized an overview of the current situation and challenges of each ASEAN country regarding Disaster Management Information System (DMIS) and education for disaster prevention and mitigation.

5.1 Disaster Management Information System (DMIS)

Table 5.1.1 Information System on Disaster Management (Thailand)

		Availability	Competent Agency
Disaster Management Information System		-	-
Disaster Loss Database		-*	-
Early Warning System	Flood	○	TMD
	Flash Flood	-	-
	Typhoon/Cyclone	○	TMD
	Landslide	○*	DMR
	Tsunami	○	NDWC
	Volcano		
	Drought	○*	

Source: JICA Study Team, (*) HFA Progress Report (2009-2011) (Legend: ○: available, -: not available)

(1) DMIS and Disaster Loss Database

Various agencies responsible for monitoring meteorological, hydrological and earthquake information (e.g. NDWC, TMD, DWR and RID) collect sets of data (e.g. rainfall, water levels, and seismic data) using observation networks and manage data on database systems. However, some of the databases are isolated. There is a need to integrate their databases.

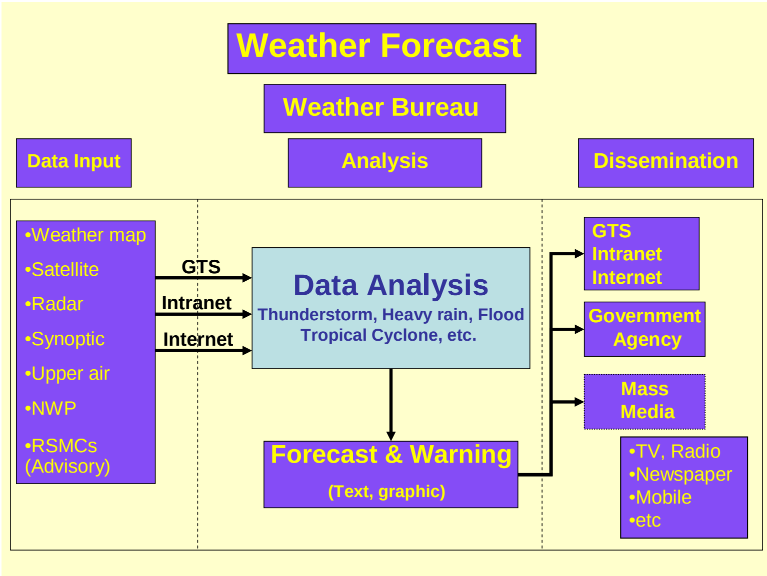
Whether DDPM has developed a DMIS and disaster loss database is yet unconfirmed.

(2) Early Warning System (EWS)

Flood warning and cyclone warning is under the responsibility of TMD, landslide warnings under DMR, and tsunami warnings under NDWC.

NDWC was established in the wake of the experience of the devastating tsunami disaster in 2004. NDWC is in charge of natural disasters only (e.g. geological disasters, hydrological disasters, meteorological disasters, and forest fires). Epidemic and chemical disasters are under the responsibility of DDPM.

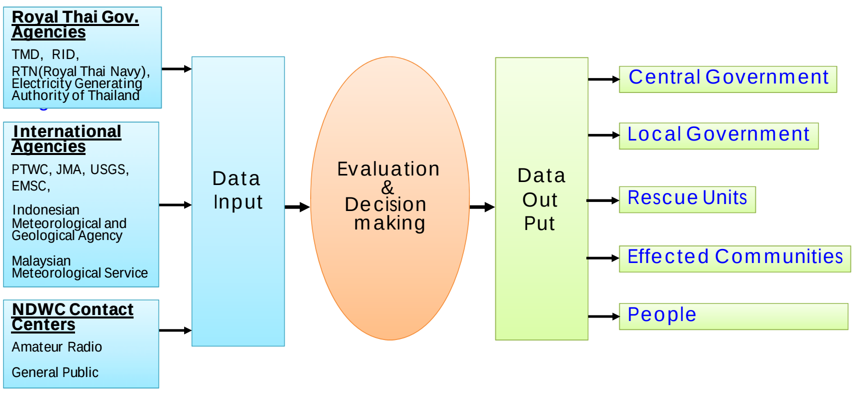
The TMD issues weather forecast and early warning based on meteorological observation data, weather maps, satellite images, weather radars, and so on. TMD delivers forecast and warning to the central government and relevant agencies, local governments, local meteorological observatories, and mass media (e.g. television, radio, newspaper).



Source: TMD, Presentation material (PowerPoint)

Figure 5.1.1 Weather Forecast and Warning Mechanism

The NDWC issues tsunami early warning based on input data from TMD, RID, Royal Thai Navy (RTN), international organizations (e.g. PTWC, JMA, USGS), and NDWC Contact Center (e.g. amateur radio, general public). NDWC then delivers the tsunami warning to the central government and local governments, rescue units, affected communities and people.

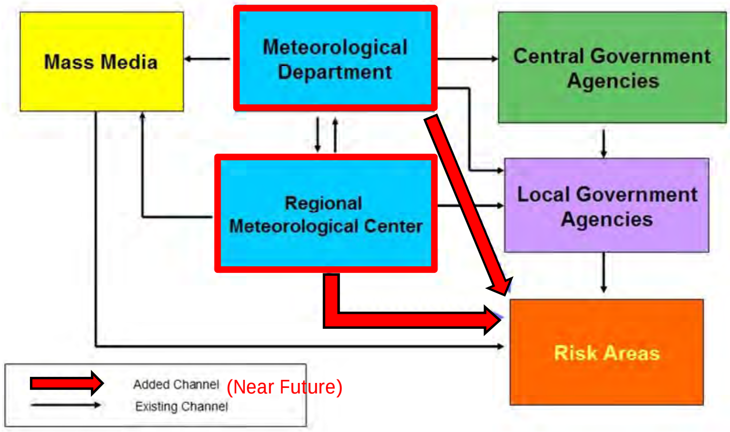


Source: NDWC, Thailand Activities on Disaster Warning at NDWC Operation Center (PowerPoint), simplified by the JICA Study Team

Figure 5.1.2 Tsunami Warning Mechanism

(3) Means of Dissemination of Early Warning

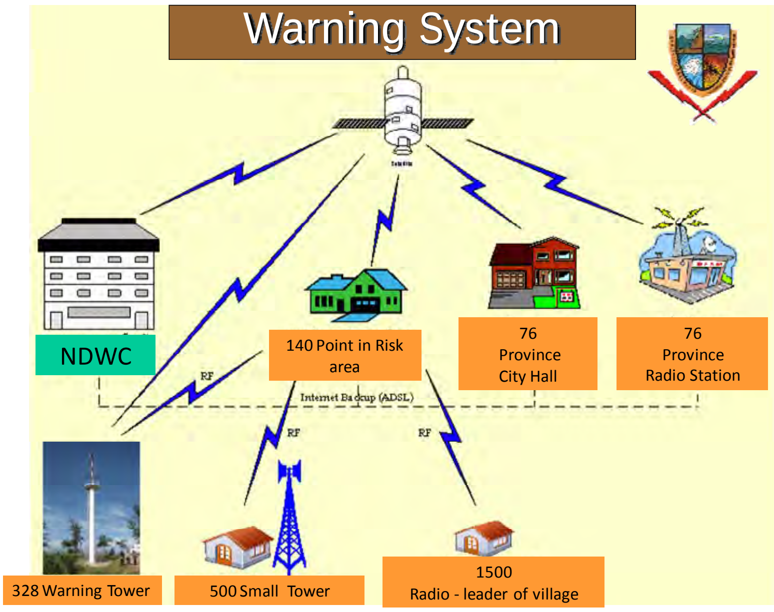
The TMD disseminates early warnings to the public through mass media (e.g. television, radio, newspaper) and local government agencies. TMD is planning to add a way to disseminate early warning directly from TMD and local meteorological observatories to risk areas.



Source: TMD, Presentation material (PowerPoint), red frames added by the JICA Study Team

Figure 5.1.3 Dissemination Flow of Weather Forecast and Warning

In case of NDMC, the means of dissemination are SMS (more than 20 million mobile phones), fax (16 ports), e-mail, mass media (television, radio), warning towers (328 towers, installed also inland), local dissemination network (500 small towers and 1,500 special radios for leaders of village), and so on. Warning towers are 25 m in height and can broadcast sirens and pre-recorded voice messages (in multiple languages). A single tower can cover up to 4 km radius.



Source: NDWC, Thailand Activities on Disaster Warning at NDWC Operation Center (PowerPoint)

Figure 5.1.4 Warning System of NDWC

5.2 Education for Disaster Prevention and Mitigation

According to the HFA Progress Report (2009-2011), there is no primary school or secondary disaster prevention and mitigation school curriculum, although various organizations are conducting disaster education at schools in each local government. For example, NDWC and TMD has created and distributed educational materials such as booklets, posters, etc for students. Large-scale evacuation trainings were implemented three or more times since 2006. However, according to a report, school curricula, education material and trainings are not promoted widely.

For universities, disasters are included in many courses such as natural disasters, earthquakes, so as to enable university student to be aware of hazards in Thailand and on how to properly handle them. Thai universities, in collaboration with the government and private sectors, regularly conduct research and academic activities on disaster preparednes [1].

From the experience of large-scale disasters caused by floods in November 2011, DDPM recognizes the importance that local governments and local communities understand sufficiently disaster risk in their area. It is necessary to create and announce hazard maps in high resolution to identify areas with high risk. High resolution maps help in considering options on how to avoid accidents in high risk areas. To do so, it is important to prepare and share information related to disaster prevention and mitigation among stakeholders in all levels.

5.3 Issues and Needs Identified - Thailand

The JICA Study Team identified the issues and needs as shown in the Table 5.3.1.

Table 5.3.1 Issues and Needs Identified by the Study Team (Thailand)

Issues and Needs	Bilateral cooperation
Development of Disaster Management Information System	Development of disaster management information system based on GIS (Considered to be capable to make it).

Source: JICA Study Team

[1] Source: HFA Progress Report (2009-2011)

CHAPTER 6 PREPAREDNESS FOR EFFECTIVE RESPONSE

6.1 Current Situation of Preparedness for Emergency Response

Emergency relief system together with other arrangements for disaster management is a part of Thailand's National Economic and Social Development Plan (both the 10th and the 11th plans).

The National Disaster Prevention and Mitigation Plan B.E. 2553-2557 (2010-2014) contain the strategies on "preparedness arrangement" and "disaster emergency management". Also contained are "standing orders on disaster" which instruct the different ministries with additional duties in emergency situations and "disaster countermeasure procedures". The procedures are taken by the national command headquarters, local command centers of all levels and agencies for each stage (i.e., pre-disaster, during-disaster and post-disaster stages) of 14 defined disasters. In accordance with the national plan, all provinces are supposed to prepare their respective plans.

The emergency center with eight divisions consisting of various agencies is put in place during disaster.

In response to the flood disaster in 2011, DDPM will prepare more practical emergency response plan. Also, a disaster-by-disaster master plan is supposed to be prepared for effective response.

Thailand is legally required to test the plan, monitor and evaluate the efficiency of the process. The simulated exercises are conducted every year by assuming a specific type of disaster, which is also aimed for enhancing the capacity and skills of the emergency response teams for real situations. These exercises are implemented at the national, cluster provincial, provincial and district levels. These also help people to be well-prepared for the onset of disasters.

As for financial arrangements, there are victim compensation and recovery budgets for flood-affected provinces additionally approved for recent disasters.

6.2 Issues and Needs of Assistance for Emergency Response

(1) Issues[1]

a) To formulate master plans for various disasters.

b) To improve information sharing among government agencies on disasters

c) To improve the compensation mechanism

d) To share the victims' database prepared at local level with the central government for verification

[1] The view in a) is identified by the JICA Study Team, while the views in b), c) and d) are identified in Thailand (2011) *National Progress Report on the Implementation of the Hyogo Framework for Action (2009-2011).*

(2) Needs[2]

a) Preparation of disaster-by-disaster master plans
b) Re-arrangement and integration of disaster management information system
c) Reformation of compensation mechanism by integrating victims' database

[2] All the views are identified by the JICA Study Team.

CHAPTER 7 NEEDS IDENTIFICATION FOR DISASTER MANAGEMENT

This chapter summarizes the survey results and describes the proposals for ASEAN regional collaboration in disaster management.

7.1 Issues and Needs According to Themes

7.1.1 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 7.1.1 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		O				O		O	
	Enacted <Planned> Year		2006[*1]	<2013>	2007	<2013>	-[*2]	<2012>	2010	-[*3]	2007	<2013>
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 7.1.1 summarises the institutional/organizational conditions of ASEAN countries.

According to the information in Table 7.1.1 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 7.1.2. 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 7.1.3.

Table 7.1.2 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
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 7.1.3 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

7.1.2 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 7.1.4 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.

Efforts have been made by ASEAN member countries in order to prepare hazard maps as shown in Table 7.1.4. 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 7.1.5 for better understanding.

Table 7.1.5 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 7.1.6 and Table 7.1.7 list example information required for corresponding purposes at the national and local levels, as well as for the local and community levels, respectively.

Table 7.1.6 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 7.1.7 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)

The common issues and needs on flood disasters for ASEAN countries are summarized in Table 7.1.8 below.

Table 7.1.8 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)

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 7.1.9 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 7.1.10 below. For reference, the number of monitoring points in Japan is included.

Table 7.1.10 Present Situation of Monitoring and Early Warning System in ASEAN Region

Country		Broadband Seismograph	Accelero-graph	GPS	Tsunami Buoy	Tsunami Gage	EWS for Tsunami	Warning System
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 7.1.10.

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 7.1.10, 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.

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[1] "Fundamental Research and Monitoring Plan for Earthquake", August 1997, Headquarters for Earthquake Research Promotion, Japan (in (In Japanese)
[2] Indonesia Tsunami Early Warning System (InaTEWS): Concept and Implementation (2008)

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 7.1.10. 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.
- 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 7.1.10) 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)

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

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.
- 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.
- 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 7.1.10) 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).

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 7.1.10. 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 7.1.11 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 7.1.12.

Table 7.1.12 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 7.1.13 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 7.1.13.

Table 7.1.14 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.

7.1.3 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 7.1.15 below.

Table 7.1.15 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 7.1.16 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.

In addition to school disaster education, community education is also necessary based on CBDRM. Interchange of disaster knowledge and sharing information among communities are

5 All the views are attributed to JICA Study Team.

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 7.1.17 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

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

7.1.4 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. However, the information routes from administrative agencies to public/communities have not necessarily been established. Table 7.1.18 shows the present situation of the availability of early warning mechanism.

Table 7.1.18 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.

[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

Table 7.1.19 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

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.

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)

(2) Disaster Preparedness

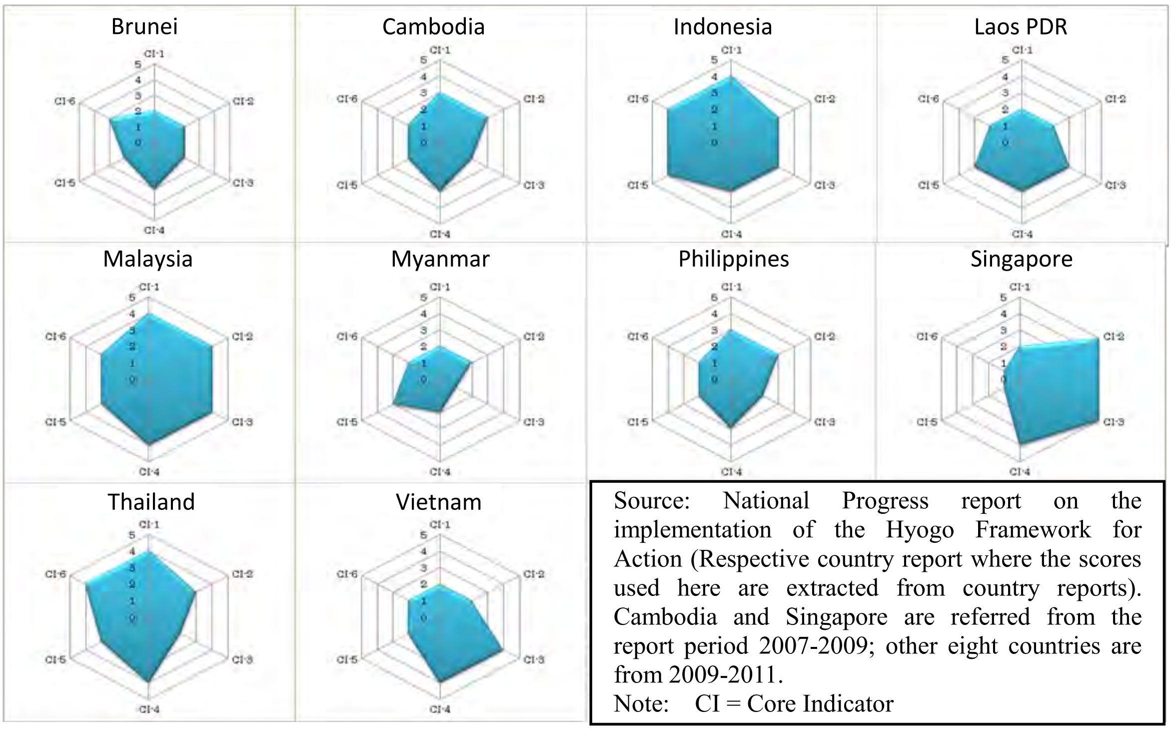
There are six core indicators proposed and used for HFA concerning “reduce the underlying risk factors”.

Table 7.1.20 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 7.1.1 below 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 7.1.1 Results of Grading HFA 4 Core Indicators by 10 ASEAN Countries

Glancing over above Figure 7.1.1 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 7.1.21 shows indicator by issues in relevant countries (principally countries graded 2 or below were chosen), which gives ideas on necessary assistance.

Table 7.1.21 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 7.1.22 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 7.1.22 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.

7.2 Aid Projects Identified

7.2.1 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.

[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.

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 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 7.2.1 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

7.2.2 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

[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)

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;

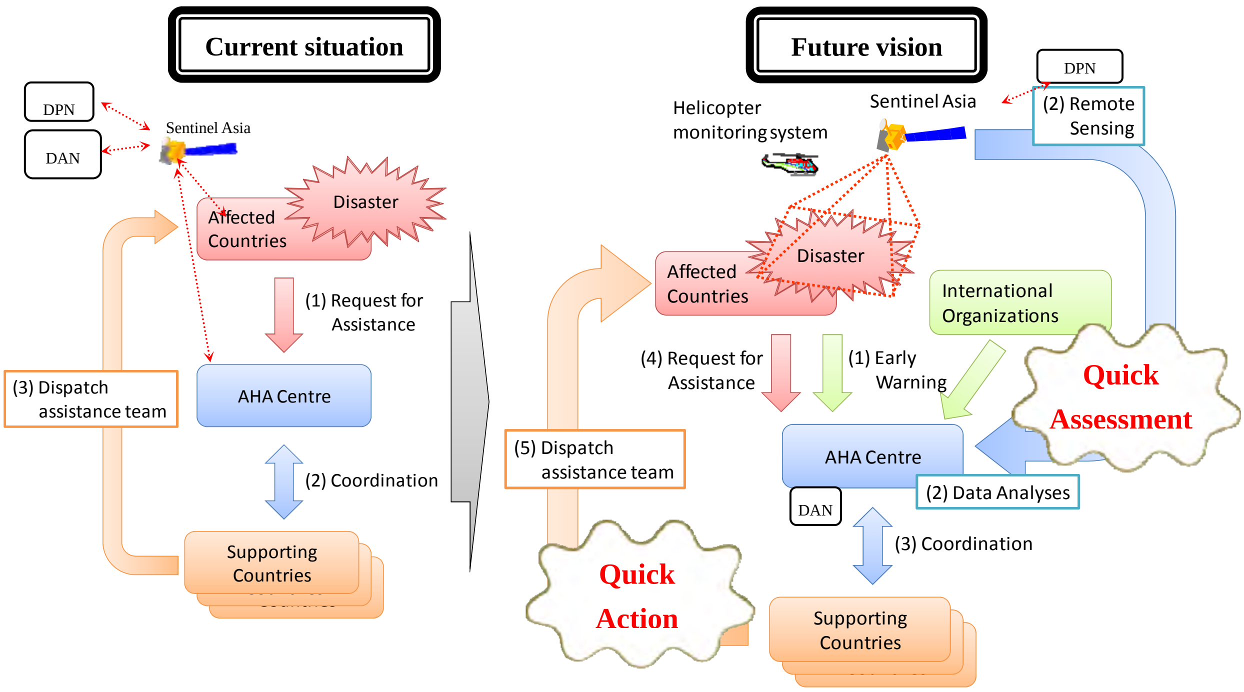
b) Sentinel Asia to request satellite data providers (called as Data Provider Nodes) for satellite images (raw digital information) concerned;

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



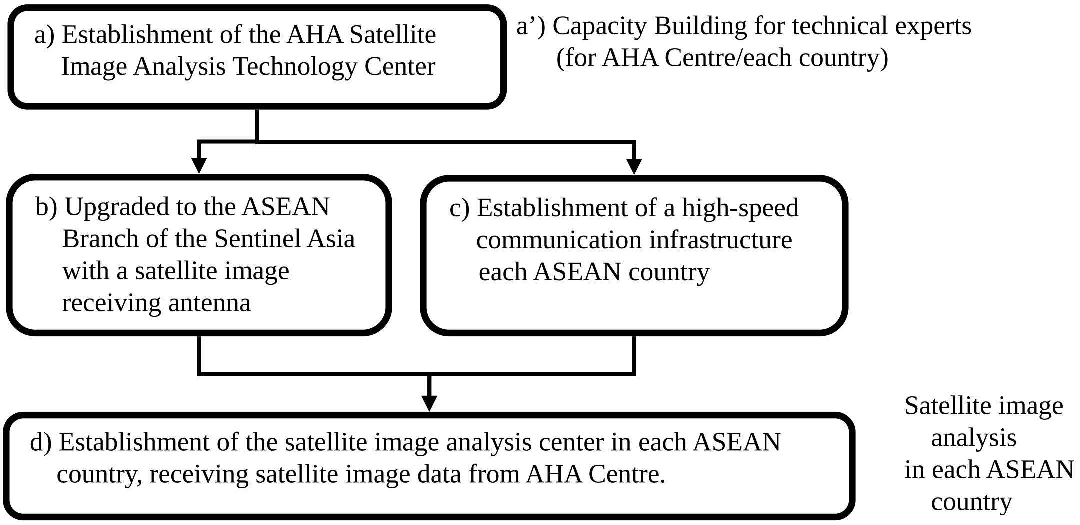
Source: JICA Study Team

Figure 7.2.1 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 7.2.2 and are also illustrated in Figure 7.2.2 below.



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

Figure 7.2.2 Recommended Flow of Steps to be Taken

Table 7.2.2 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 7.2.3 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

7.2.3 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 7.2.4 Draft Work Items – Bi-lateral Cooperation

<table>
<tr><th>Phase 1 Natural Disaster Risk Assessment</th><th>Phase 2 Regional BCP</th></tr>
<tr><td>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.</td><td>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）</td></tr>
<tr><td colspan="2">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.</td></tr>
</table>

Source: JICA Study Team

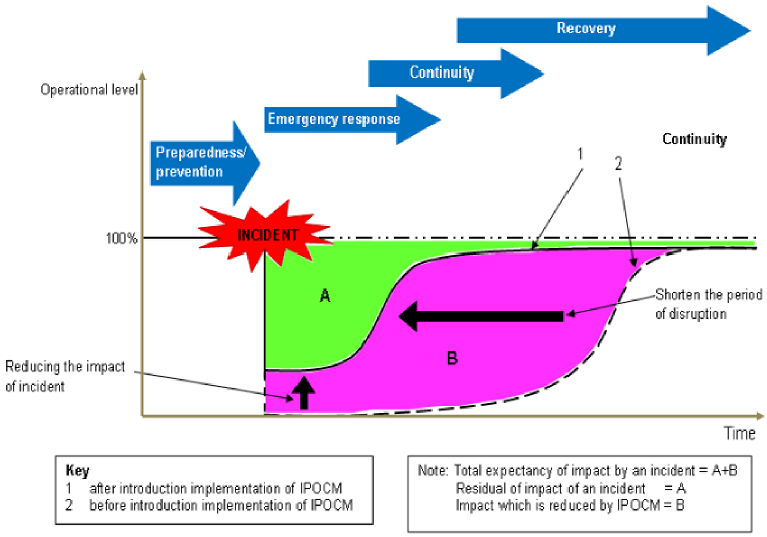
(5) Implementation Framework as ASEAN Regional Collaboration

Proposed implementation framework is shown in Table 7.2.5 below.

Table 7.2.5 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 7.2.3 Concept of Disaster Preparedness and BCP

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

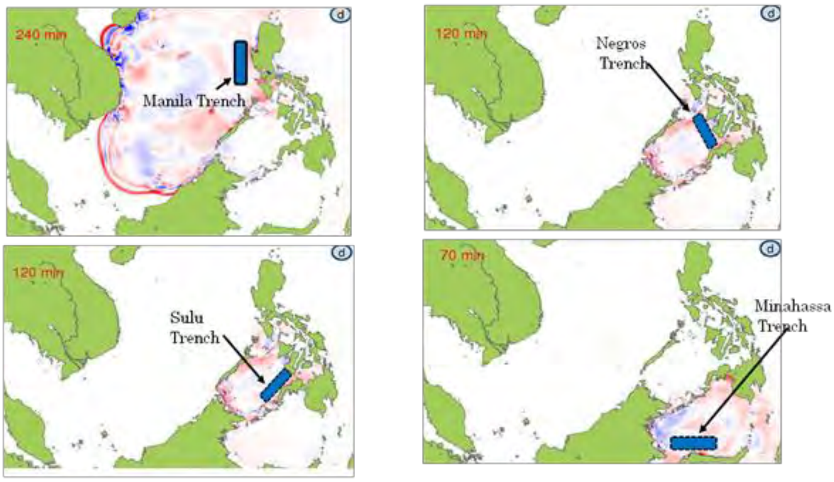
(1) Background

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 7.2.4 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 7.2.6 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 7.2.5.

(6) Implementation Period

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

Table 7.2.7 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

7.2.5 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.

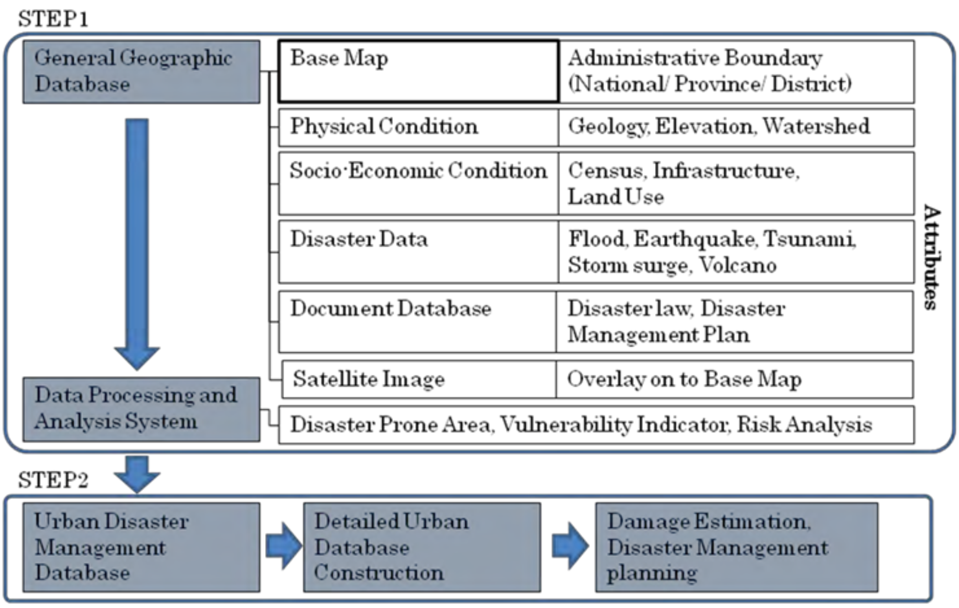
It is understood that the project for the development and deployment of Disaster Monitoring and Response System (DMRS) for the AHA Centre was launched in April 2012. It is expected that the system will offer early warning and decision support systems to be customized for the needs of AHA Centre and the 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 7.2.5

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



Source: JICA Study Team

Figure 7.2.5 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 7.2.8 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 7.2.8 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 7.2.9 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 7.2.10 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

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

(1) Background

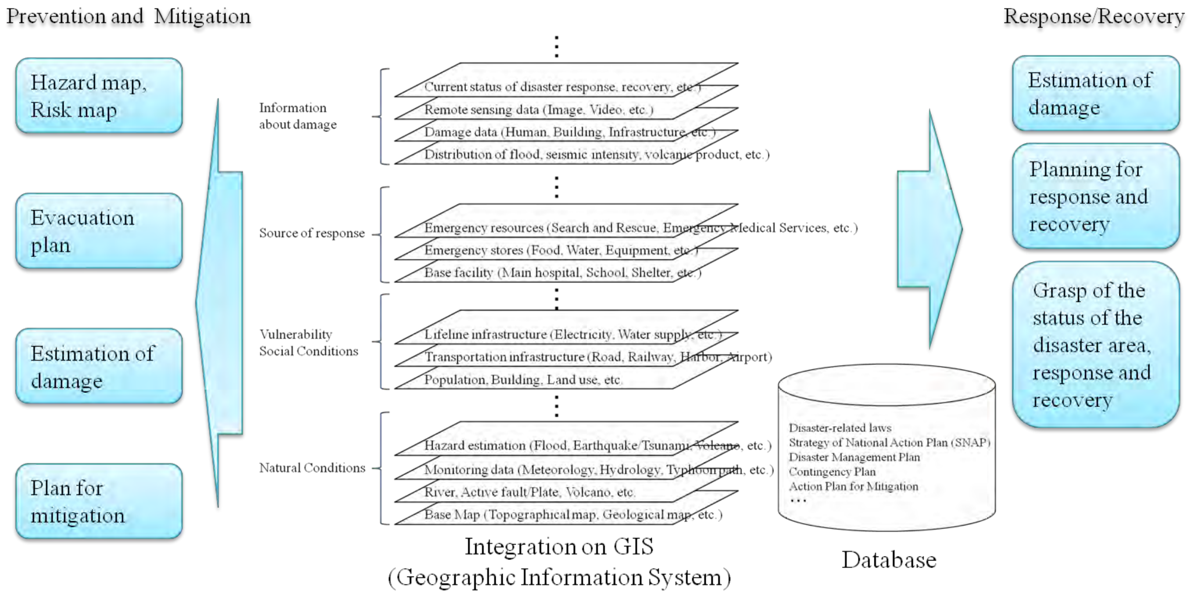
In order to materialize the disaster risk reduction, conducting disaster risk assessment should be a prerequisite condition. This will require various sets of information regarding past disaster records, socio-economic conditions, natural, and physical constitutions, and so on. Therefore, DMIS should 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 7.2.6 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 7.2.11 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

7.2.7 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.