Country Report

Thailand

Natural Disaster Risk Assessment and
Area Business Continuity Plan Formulation for
Industrial Agglomerated Areas in the ASEAN Region

March 2015

AHA CENTRE

Japan International Cooperation Agency

OYO International Corporation
Mitsubishi Research Institute, Inc.
CTI Engineering International Co., Ltd.

Overview of the Country

Basic Information of Thailand [1), 2), 3)]

National Flag

Country Name	Long form: Kingdom of Thailand Short form: Thailand	
Capital	Bangkok	
Area (km²)	Total : 513,120 Land : 510,890 Inland Water : 2,230	
Population		67,010,502
Population density (people/km² of land area)		131
Population growth (annual %)		0.3
Urban population (% of total)		48
Languages	Thai	
Ethnic Groups	The dominant ethnic group is Thai. Other ethnic groups include Chinese, Malay and hill-tribe minority groups.	
Religions	Buddhism 94%, Islam 5%	
GDP (current US$) (billion)		387
GNI per capita, PPP (current international $)		13,510
GDP growth (annual %)		1.8
Agriculture, value added (% of GDP)		12
Industry, value added (% of GDP)		43
Services, etc., value added (% of GDP)		45

Brief Description

Thailand occupies the Indochina peninsula and northern part of the Malay Peninsula. Thai is the dominant ethnic group of Thailand. Northern Thailand is mountainous, with farmland spread across central and southern Thailand. The Chao Phraya River flows through Central Thailand and the Mekong River runs along the border between Laos.

Thailand is one of the founding members of ASEAN (founded on August 8, 1967). Thailand serves as a trading hub between foreign countries and other ASEAN countries.

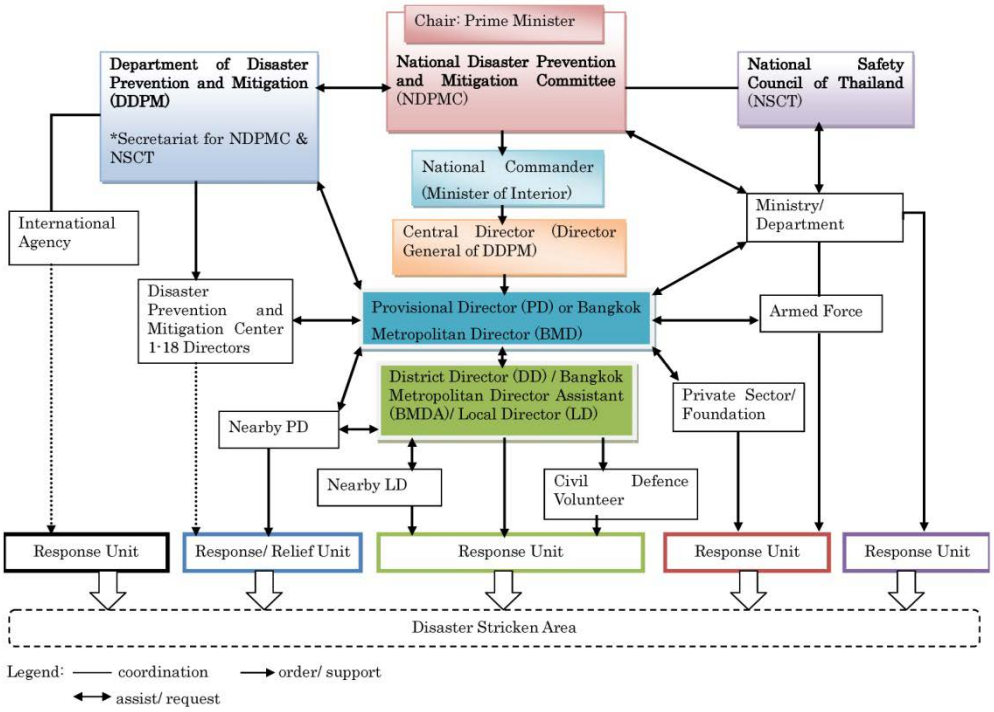
Thailand is a constitutional monarchy. The head of state is King Bhumibol Adulyadej, and Prime Minister Yingluch Shinawatra is the head of government. Continuing from the former Thaksin administration, the government pursues economic diplomacy aiming at the conclusion of free trade agreements.

Natural Hazards

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.

Disaster Management System [4)]



References:

1) Central Intelligence Agency (CIA) website (2014): https://www.cia.gov (Accessed: October 15, 2014)

2) Ministry of Foreign Affairs website (2014): http://www.mofa.go.jp (Accessed: October 15, 2014)

3) The World Bank Data Bank website (2013): http://data.worldbank.org (Accessed: October 15, 2014)

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

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1. Introduction

This report is the first version of the Country Report for Thailand, which gives information on natural disaster risks of the country, industrial parks, major traffic infrastructure and lifeline utilities, and legislative systems relating to disaster management and business continuity.

The country report is prepared as a reference document for individuals and organizations who are wishing to integrate disaster risk information for their decisions: such as investment to Thailand, preparation of a business continuity plan (BCP) or disaster management plan of their organization, preparation of an Area Business Continuity Plan (Area BCP) of their area, and simply knowing natural disaster risks of their area.

Information contained in this report is macroscopic covering the entire country at the same level. When detailed risk information is necessary, hazard and risk assessments for an area of interest are required.

Since the country report was prepared with limited data and information as one of the components of the project[1] of ASEAN Coordinating Centre for Humanitarian Assistance on Disaster Management (AHA Centre) and Japan International Cooperation Agency (JICA) with a limited data and information, a revision by national experts is required for further refinement.

The following are reference documents prepared by the project of AHA Centre and JICA.

1. AHA Centre and JICA (2015): Planning Guide for Area Business Continuity, Area BCM Took Kit, Version 2.

2. AHA Centre and JICA (2015): The Country Reports; Brunei, Cambodia, Indonesia, Laos, Malaysia, Myanmar, the Philippines, Singapore and Vietnam.

3. AHA Centre and JICA (2015): The Risk Profile Reports; Karawang and Bekasi of Indonesia, Cavite, Laguna and the Southern Part of Metropolitan Manila of the Philippines, and Haiphong of Vietnam.

[1] Natural Disaster Risk Assessment and Area Business Continuity Plan Formulation for Industrial Agglomerated Areas in the ASEAN Region, AHA Centre and JICA, 2013 to 2015.

2. Natural Disaster Risks

2.1 Predominant Hazards

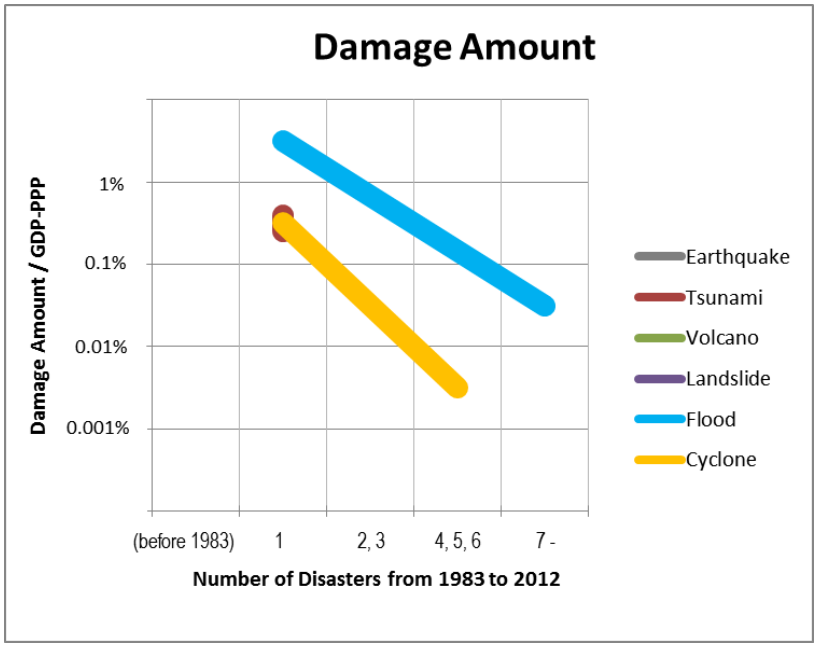
In Thailand, floods occur frequently and their impact is the largest in terms of the amount of economic damage caused. Cyclones have the next biggest economic impact. 58% of the disasters recorded during 1983 and 2012 were caused by floods followed by storms (29%), while floods (58%) and drought (37%) were the two major disasters that affected the largest number of people. As for the estimated damage cost (economic loss), floods were responsible for 95% of total economic losses, most of which was caused by the flood in 2011 that generated a US$40 million loss.

The largest human loss in the last 30 years was caused by the 2004 Indian Ocean Tsunami and there are no records of similar scale events occurring, even in historical documents. 65% of the total disaster related deaths between 1982 and 2012 in Thailand were caused by this tsunami which was induced by the Sumatra Earthquake in 2004. On the other hand, flood caused 27% of the total disaster related deaths that are largely attributed to the flood disaster of 2011.

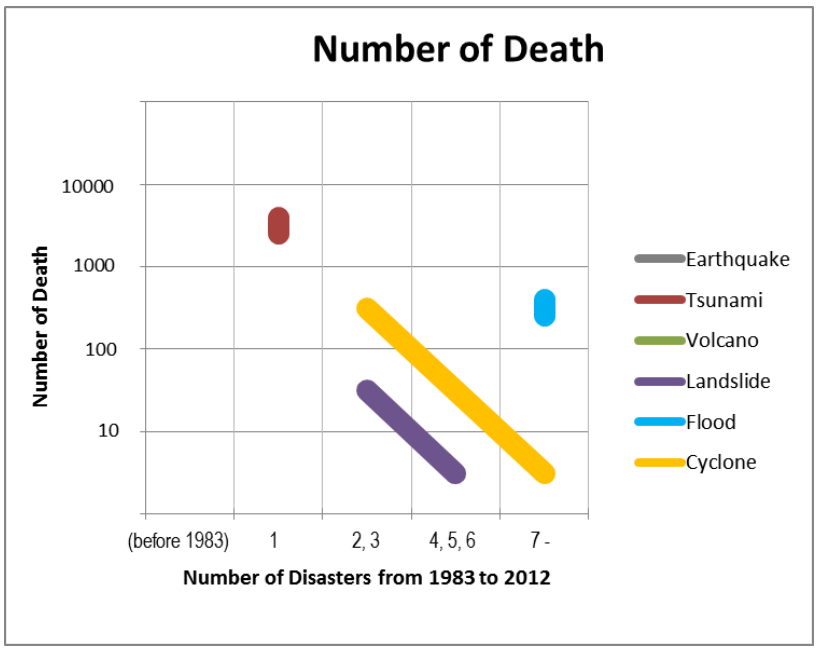
The records of natural disasters that have affected Thailand are classified based on the impact and frequency of occurrence in Figure 2.1. Both "damage amount" and "number of deaths" are used to express the impact, and "number of disasters occurred between 1983 and 2012" is used to represent the frequency of occurrence.

Figure 2.1 can be used to see the relative level of risk of natural hazards in Thailand according to their impacts and frequency of occurrence. Descriptions of each hazard are given in Section 2.2 to Section 2.7.

Please note that the figure was prepared by the available existing information, and not all information relating to the impacts of disasters was included. Further collection of information and discussion among experts of Thailand will be necessary to improve on the information represented in Figure 2.1.



Note: GDP-PPP, Gross domestic product based on purchasing-power-parity (PPP) valuation of country GDP, International Monetary Fund, World Economic Outlook Database, October 2012



Source of data and information:

EM-DAT, The OFDA/CRED International Disaster Database, Université catholique de Louvain, Brussels, Belgium: http://www.emdat.be.
Pacific Rim Coordination Center Disaster Data: http://data.pacificrimnetwork.org/.
Global Unique Disaster Identification Number: http://www.glidenumber.net/glide/public/search/search.jsp.
National Geophysical Data Center (NGDC), National Oceanic and Atmospheric Administration (NOAA): http://ngdc.noaa.gov/hazard/hazards.shtml
Dartmouth Flood Observatory, University of Colorado: http://floodobservatory.colorado.edu/

Figure 2.1 Impact of Natural Hazards in Thailand

2.2 Flood

Risks

Locations of flood disasters in Thailand are shown in Figures 2.2 and 2.3. Circle size represents the scale of the disasters in terms of human losses and economic losses.

In Thailand, floods occur in the central part of the country, especially in the Chao Phraya River basin, caused by rainfalls in the rainy season from May to October and strong rainfalls in the monsoons from August to October. Floods are triggered by long-term rainfalls and storm rainfalls that cause water to pool in the low-lying areas of the central plain, and the prolonged floods cause human losses and economic losses. In urban areas local inundation damage occur due to insufficient drainage systems and insufficient maintenance work. Bangkok is also vulnerable to floods from the Chao Phraya and local floods because Bangkok is located downstream of the Chao Phraya River. Also, there is ground subsidence from the current overuse of groundwater for industries, etc., and insufficient capacity for the drainage system in the tidal areas.

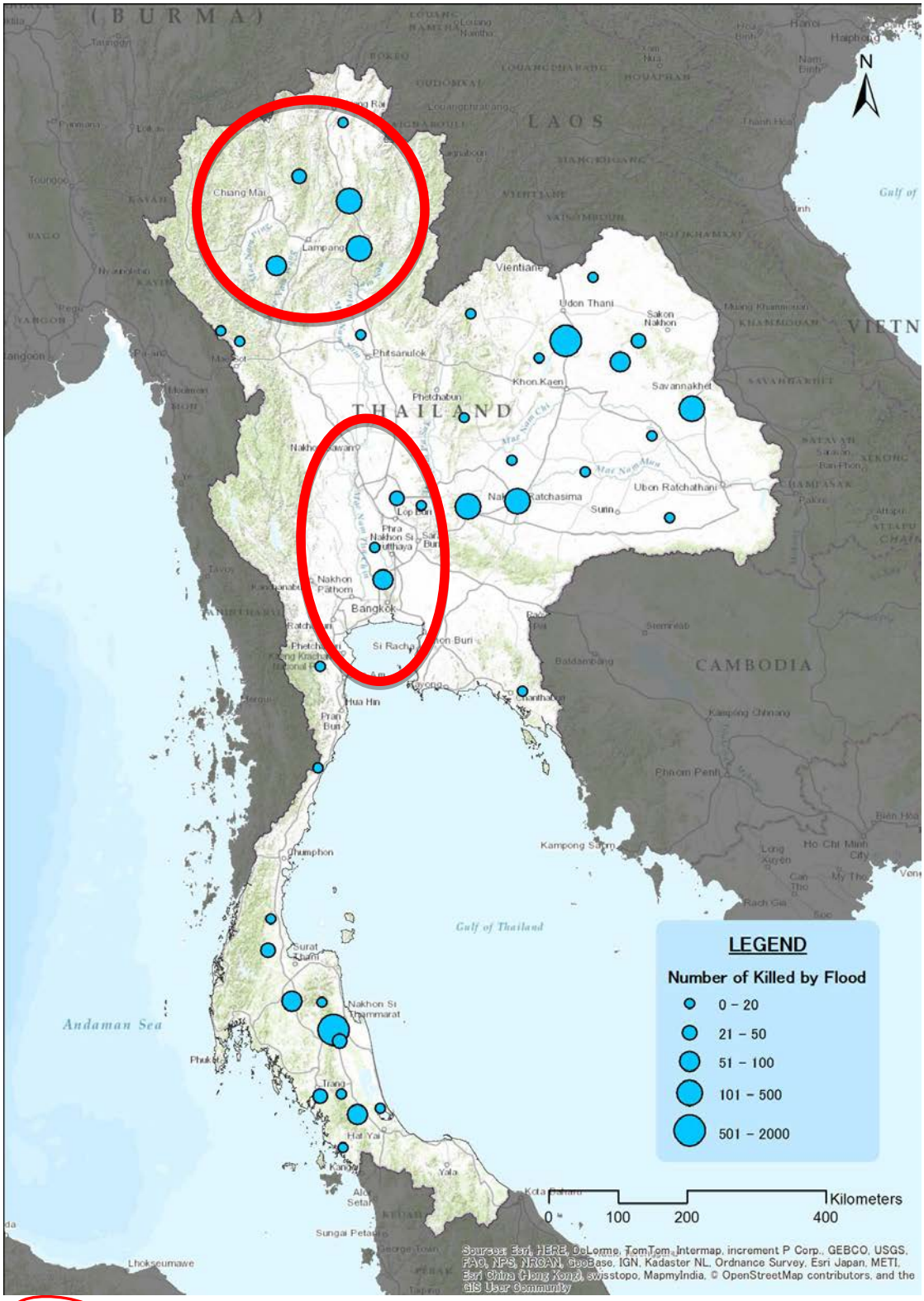
Hot spots are of flood disasters include:

- Middle reach of the Chao Phraya River Basin
- Downstream of the Chao Phraya River Basin, Bangkok and its surroundings

Recent flood disasters are:

- The flood on October 5, 2002 triggered by storm rainfall in the northern area caused damage in 43 provinces in the northern and the central parts.
- The flood of October 2008 triggered by storm rainfalls which had continued since the middle of September caused damage at Lopburi, Phitsanulok, and surrounding area in the northern area and the northeast area.
- The flood of October 2010 triggered by strong monsoon rainfalls caused severe damage at Nakhon Ratchasima in the northeast area and Ayutthaya and Lopburi in the central area.
- The flood from August 2011 to January 2012 was said to be a 100-year flood in terms of probability. It caused inundation damages at industrial estates together with Bangkok, Ayutthya, and the many cities for more than three months at the

middle reach and lower reach of the Chao Phraya River Basin. As the results, the damage caused a worldwide shortage of parts supplied from Thailand.

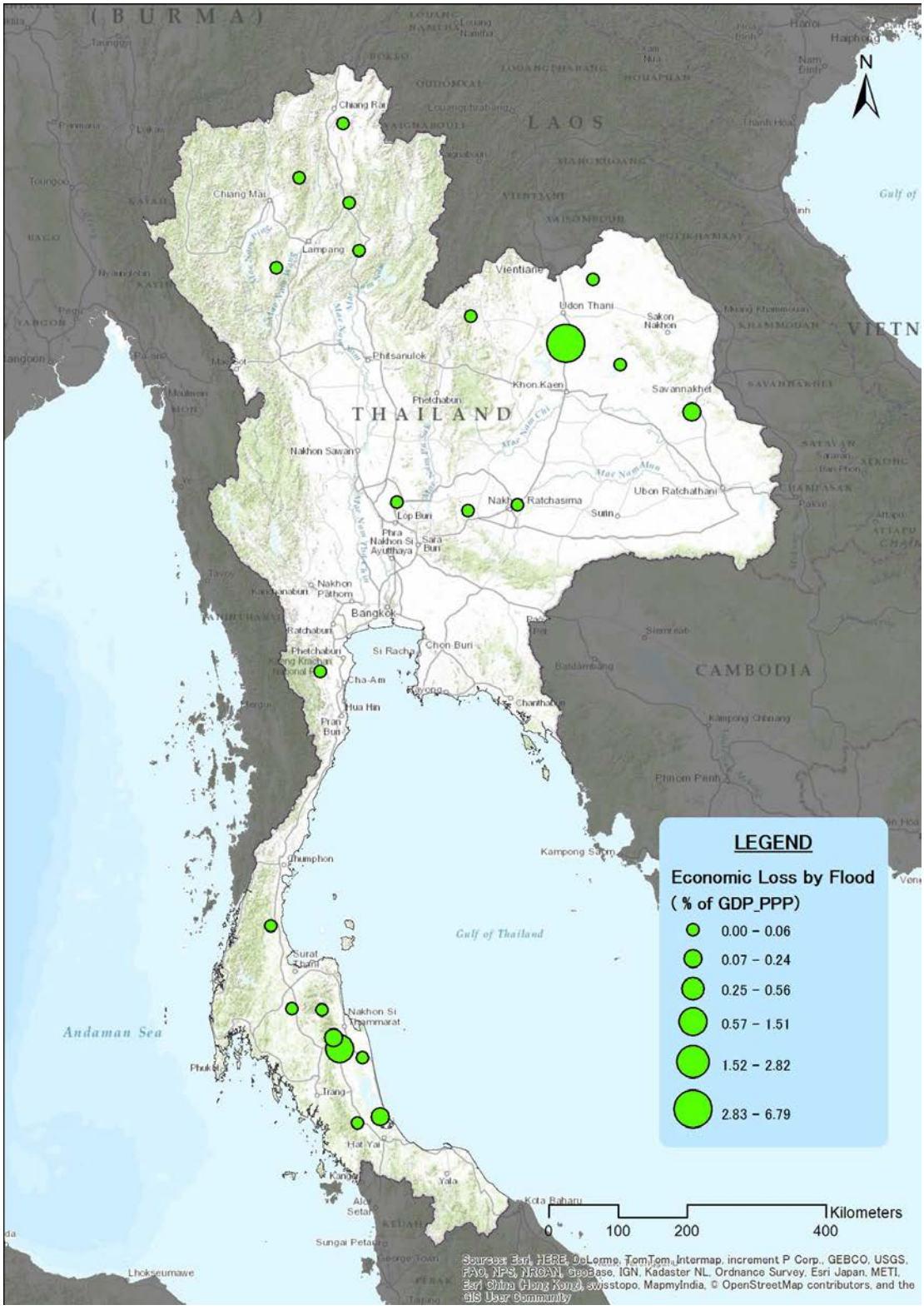


: Hot Spots

Data Sources:

EM-DAT, The OFDA/CRED International Disaster Database, Université catholique de Louvain, Brussels, Belgium: http://www.emdat.be.
Pacific Rim Coordination Center Disaster Data: http://data.pacificrimnetwork.org/.
Global Unique Disaster Identification Number: http://www.glidenumber.net/glide/public/search/search.jsp.

Figure 2.2 Locations of Flood Disasters in Thailand: Human Losses



Data Sources:

EM-DAT, The OFDA/CRED International Disaster Database, Université catholique de Louvain, Brussels, Belgium: http://www.emdat.be.
Pacific Rim Coordination Center Disaster Data: http://data.pacificrimnetwork.org/.
Global Unique Disaster Identification Number: http://www.glidenumber.net/glide/public/search/search.jsp.

Figure 2.3 Locations of Flood Disasters in Thailand: Economic Losses (% of GDP)

Background

Floods mostly occur in the Chao Phraya River Basin from August to October. Rainfalls in the mountainous region of the northern part of the basin inundate the central plain of the Chao Phraya River for a few months. Bangkok and the other major cities in the Chao Phraya River Basin are promoting flood control measures like ring dykes.

Sources of Hazard and Risk Information

Table 2.1 Sources of Hazard and Risk Information: Flood

National Disaster Prevention and Mitigation Committee (NDPMO)
National Security Division (NSD)
The Provincial Disaster Prevention and Mitigation Committee(DPMC)
Department of Disaster Prevention and Mitigation, Ministry of Interior (DDPM)
http://www.disaster.go.th/dpm/index.php?option=com_content&task=view&id=13&Itemid=135
Thai Meteorological Department (TMD)
http://www.tmd.go.th/en/
Chulalongkorn University (CU)
http://www.chula.ac.th/cuen/index.htm
King Mongkut's Institute of Technology Ladkrabang (KMITL)
http://www.kmitl.ac.th/en/main.php

Studies on Hazard and/or Risk Assessment

Some useful studies on flood hazard, risk, and vulnerability are publicly available presenting assessment results, case studies of countermeasures, as well as different methodological approaches. There are a few types of methodologies to assess risks and vulnerability including, for example, risks involving exposure to flooding events and population density. Vulnerability can be defined as a function of exposure, adaptive or coping capacity, and land-use etc. There are slightly different

combinations of these factors with different studies for use. Therefore, these concepts must be defined in advance to plan a methodology for an assessment, in terms of which definitions are to be used in a certain analysis.

Locations of existing investigations and studies on flood are shown in Figure 2.4. Outline of those investigations and studies are attached in Appendix 2 and their summary is given in Table 2.2.

Table 2.2 Summary of Existing Investigations and Studies: Flood

Country/Region	Summary of Existing Studies and Reports
ASEAN	There are a few reports that study natural disasters for ASEAN and the Pacific regions at large in recent years. Disaster risks are assessed by scenario, exposure, vulnerability, damage, and loss. An assessment framework is also sought to give an overview of risks, hazard and vulnerability.
Thailand	GISDA is producing GIS maps on flooding. World Bank undertook an assessment of the damage and losses caused by the flood of the Chao Phraya river in 2011. There is a flood risk assessment case study to evaluate susceptibility to hazard and risks. Reducing vulnerability is also a key to lowering risks. Examples of non-structural risk reduction measures are also presented.

Figure 2.4 Locations of Existing Investigations and Studies: Flood

References for Data and Further Reading

1) Asian Disaster Preparedness Center (2011) Program for Hydro-Meteorological Disaster Mitigation in Secondary Cities in Asia (PROMISE) 2005 to 2010: Bangkok
2) ADRC: “Thailand , Tropical Storm, Flood , 2011/08/03”.
3) ADRC: “Thailand , Flash flood ,2010/10/16”.
4) ADRC: “Thailand, Flash flood, 2010/10/16”, Details of Disaster Information.
5) Asian Disaster Reduction Center (ADRC): “Countries; Thailand”, Information on Disaster Risk Reduction of the Member.
6) ADRC: “Thailand ,Heavy rain, 2002/09/03.
7) Arief Anshory Yusuf & Herminia Francisco (2009). Climate Change Vulnerability Mapping for Southeast Asia, Singapore: EEPSEA
8) BBC NEWS (2002):“Flood devastation in northern Thailand floods affect 90,000 families”, 6 September, 2002.
9) IRIN(2008):“THAILAND: Flash floods continue to batter farmlands”.
10) Ministry of Foreign Affairs of Japan (2013): “Information on Thailand (in Japanese)”, 6 2013.
11) Relief Web; OCHA (2011):“Thailand: Time Series Analysis of Thailand Flooding 2011”, Map from UN Institute for Training and Research, UNOSAT, 22 Nov 2011.
12) Relief Web; OCHA (2010):“Flash floods kill seven in Thailand”, Report from Agence France-Presse,19 Oct 2010.
13) Relief Web; OCHA (2002): “Thailand - Floods OCHA Situation Report No. 1”,Report from UN Office for the Coordination of Humanitarian Affairs,10 Oct 2002.
14) Shigenobu Tanaka et al (2010). Progress Report on Flood Hazard Mapping in Asian Countries. PWRI.
15) Tanavud Charlchai et al, (2004) Assessment of flood risk In Hat Yai Municipality, Southern Thailand, using GIS: Journal of Natural Disaster Science, Volume 26, Number 1, 2004, pp1-14
16) Velasquez, Jerry et al (ed.) (2012). Reducing vulnerability and exposure to disasters: Asia-Pacific disaster report 2012, ESCAP/UNISDR AP
17) World Bank (2011) Thailand Flooding 2554 Rapid Assessment for Resilient Recovery and Reconstruction Planning: Bangkok

18) World Bank (2011). Advancing Disaster Risk Financing and Insurance in ASEAN Countries: Framework and Options for Implementation, Washington: Global Facility for Disaster Reduction and Recovery

19) World Bank, UNISDR (2010). Synthesis Report on Ten ASEAN Countries Disaster Risks Assessment.

2.3 Earthquake

Risks

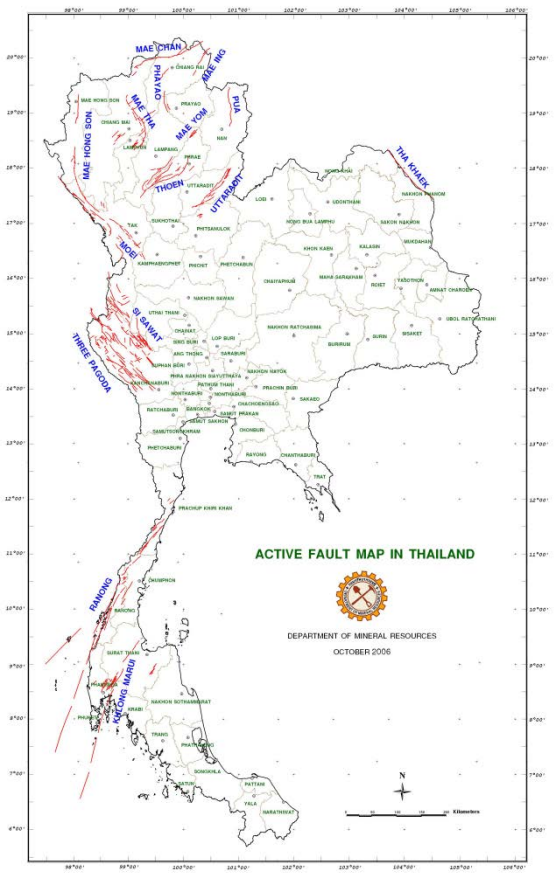
There are few records of disaster caused by earthquakes in Thailand. The earthquake that occurred in Myanmar in 2011 and the earthquake that occurred in Yunnan province of China in 1995 caused some damage in Thailand. However, the largest earthquake occurring recently in the country was an earthquake with magnitude 5.9 that occurred near Bangkok in 1983.

The area with relatively high earthquake risk is the area along the border with Myanmar.

Background

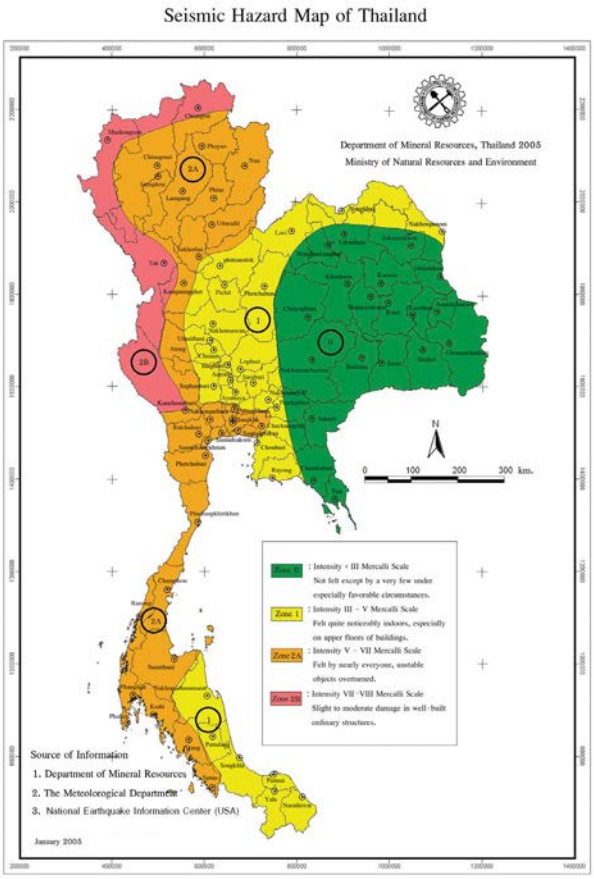
Figure 2.5 shows active faults in Thailand. Most active faults are seen along the border with Myanmar.

Figure 2.6 is a seismic hazard map prepared by the Department of Mineral Resources (DMR). The map classifies areas of country into 4 zones with seismic hazard levels. The highest seismic hazard zone is the northwest area along the border with Myanmar. The zone is evaluated as 2B where VII-VIII in the Modified Mercalli Scale is expected and described as "slight to moderate damage in well-built ordinary structures." The second highest seismic hazard zone is an area inside of the highest zone. The zone is evaluated as 2A where V-VII in Modified Mercalli Scale is expected and described as "felt by nearly everyone, unstable objects overturn."



Source : JICA (2012)

Figure 2.5 Active Fault Map in Thailand



Source : JICA (2012)

Figure2.6 Seismic Hazard Map of Thailand

Responses by Thailand

Disaster Management Information

The Department of Mineral Resources (DMR) has developed the Active Fault Map in Thailand and Seismic Hazard Map of Thailand as shown above. As for active faults, the DMR has investigated their historical activities through trenching surveys.

Early Warning and Information Transmission

An earthquake and tsunami observation network for Thailand has been implemented and strengthened after the catastrophe caused by the tsunami in 2004. The Thai Meteorological Department (TMD) installed a total of 41 broadband seismographs. 15 seismographs, manufactured in Canada, were installed in Phase-1 from 2006, and 26 seismographs, manufactured in Australia, were installed in Phase-2 from 2009.

Hypocenter and magnitude are determined by the TMD. The TMD conducts the analysis within about ten minutes. In case of an earthquake abroad, it takes about 15 minutes to analyze using the information obtained through GTS operated by the World Meteorological Organization (WMO). 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.

Preparedness and Education

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

Sources of Hazard and Risk Information

Table 2.3 Sources of Hazard and Risk Information: Earthquake

Thai Meteorological Department (TMD)
http://www.tmd.go.th/en/
Department of Mineral Resources (DMR)
http://www.dmr.go.th/main.php?filename=web_en
The National Disaster Warning Center (NDWC)
http://www.ndwc.go.th/web/

Reports on Hazard and/or Risk Assessment

Useful information and studies on earthquake hazard, risk, and vulnerability were collected from resources available in the public domain including websites. The information and studies include methodologies with analysis and assessment.

There is no standardized or authorized methodology for risk and vulnerability assessment. Therefore, the methodology should be selected or updated in accordance with the purpose when risk and vulnerability assessments are required.

Locations of existing investigations and studies on earthquake are shown in Figure 2.7. Outline of those investigations and studies are attached in Appendix 2 and their summary is given in Table 2.4.

Table 2.4 Summary of Existing Investigations and Studies: Earthquake

Country/Region	Summary of Existing Studies and Reports
ASEAN	There are natural hazard assessment reports for ASEAN region created by international organizations like World Bank etc. They summarize frequency, vulnerability, loss, and others subject for each disaster. Some reports describe the methodology and assessment points/items.
Thailand	There are few records of earthquake disaster in Thailand, but some organizations surveyed earthquake hazard.

References for Data and Further Reading

1) EM-DAT: The OFDA/CRED International Disaster Database – www.emdat.be – Université Catholique de Louvain – Brussels – Belgium.
2) Japan International Cooperation Agency (JICA) (2012): "Data Collection Survey on ASEAN Regional Collaboration in Disaster Management"
3) Mark Petersen et al. (2007). , Documentation for the Southeast Asia Seismic Hazard Maps, USGS
4) OCHA-ROAP (2011). THAILAND: Natural Hazard Risks
5) UNISDR (2009). Global assessment report on disaster risk reduction, Risk and poverty in a changing climate

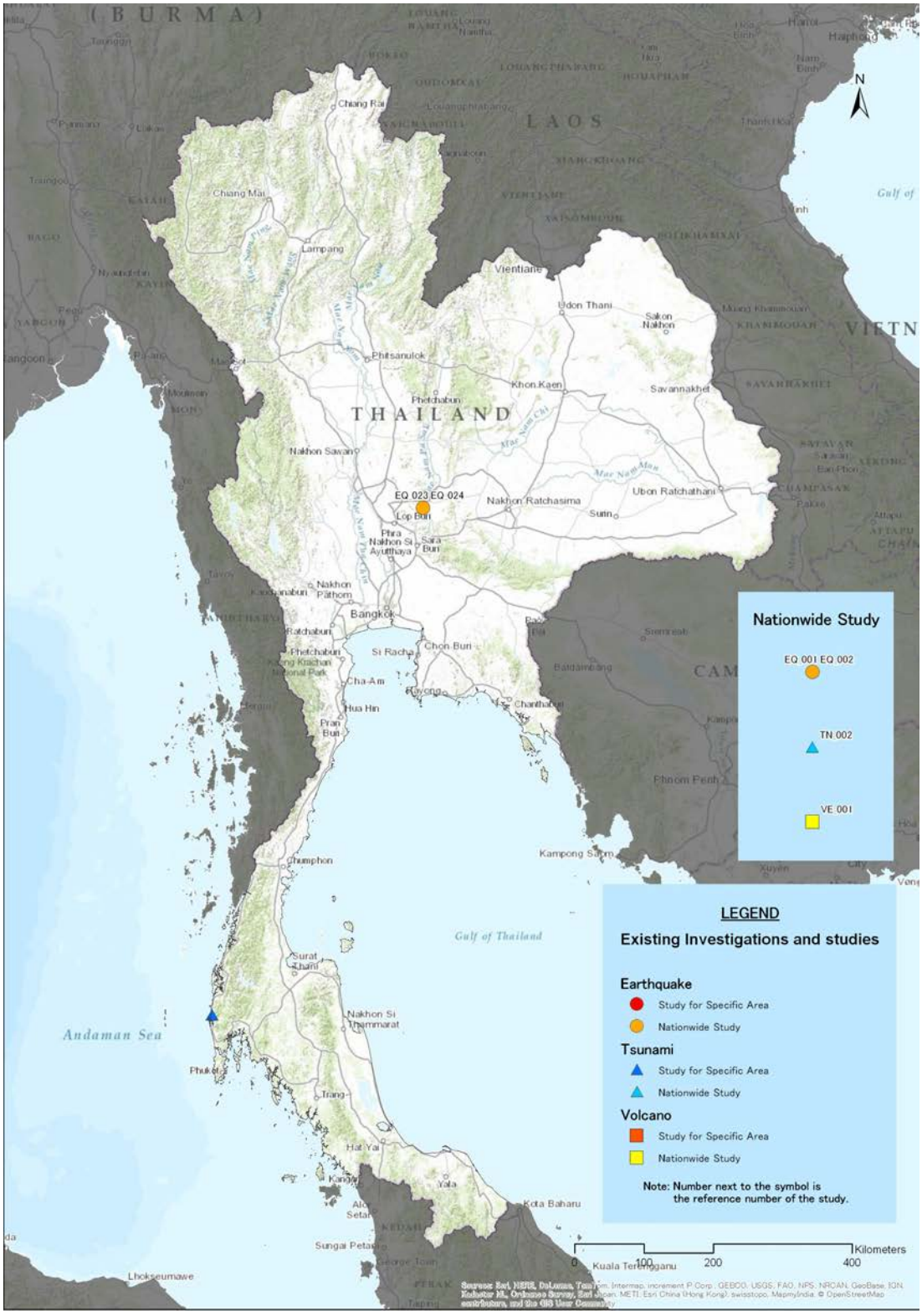


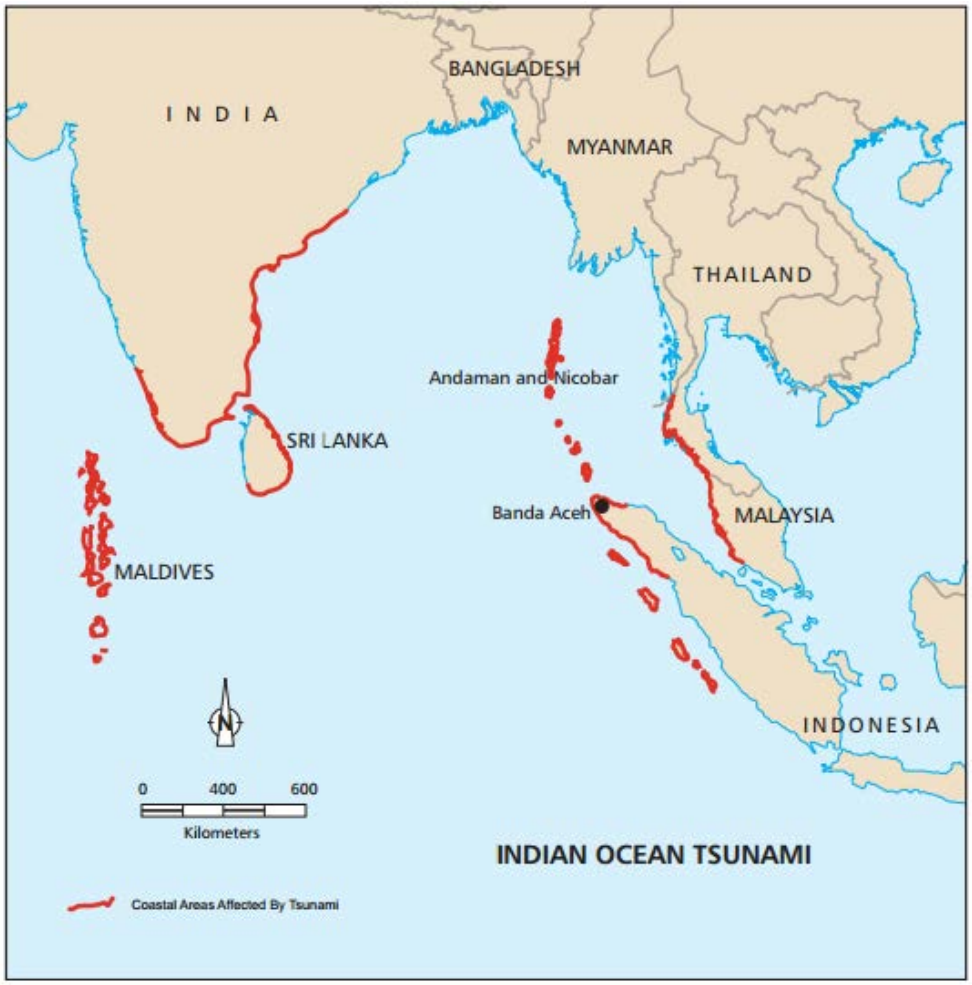
Figure 2.7 Locations of Existing Investigations and Studies: Earthquake, Tsunami and Volcano

2.4 Tsunami

Risks

The tsunami induced by 2004 Sumatra Earthquake (M9.1) caused more than 8,000 missing and dead in Phuket and other southern areas in Thailand. It also caused losses of US$ 1 billion, corresponding to 0.24% of the GDP at that time. There is another old record that a tsunami induced by an earthquake occurred in 1955 in the Indian Ocean, causing around 500 fatalities.

The tsunami disaster is not so frequent in Thailand, but it is one of the major disasters in Thailand.



Data Source:

Asia Development Bank (2005): From Disaster to Reconstruction: A report on ADB's Response to the Asian Tsunami.

Figure 2.8 Coastal Areas Affected By Tsunami by 2004 Sumatra Earthquake

Responses by Thailand

Disaster Management Information

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 damage not only due to earthquake, but also landslide by volcanic activity have been anticipated in Nicobar Island in the Andaman Sea.

Early Warning and Transmitting Information

The Meteorological Department (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 were built at 328 sites, not only in tsunami disaster areas, but throughout the entire country including mountainous areas. The warning towers along Andaman Coast were built at 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 including English, German, Chinese, Japanese, and Thai.

The National Disaster Warning Center (NDWC) issues tsunami early warnings 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.

As the means of information dissemination, NDWC uses 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 a 4 km radius.

Preparedness and Education

A considerable number of warning towers and tsunami shelters have been built in tsunami disaster areas.

Tsunami evacuation drills are conducted at schools and hotels once a year.

Sources of Hazard and Risk Information

Table 2.5 Sources of Hazard and Risk Information: Tsunami

Thai Meteorological Department (TMD)
http://www.tmd.go.th/en/
Department of Mineral Resources (DMR)
http://www.dmr.go.th/main.php?filename=web_en
The National Disaster Warning Center (NDWC)
http://www.ndwc.go.th/web/

Reports on Hazard and/or Risk Assessment

Useful information and studies on tsunami hazard, risk, and vulnerability were collected from resources available in the public domain including websites. The information and studies include methodologies with analysis and assessment.

There is no standardized or authorized methodology for risk and vulnerability assessment. Therefore, methodology should be selected or updated in accordance with the purpose when risk and vulnerability assessment are required.

Locations of existing investigations and studies on tsunami are shown in Figure 2.7. Outline of those investigations and studies are attached in Appendix 2 and their summary is given in Table 2.6.

Table 2.6 Summary of Existing Investigations and Studies: Tsunami

Country/Region	Summary of Existing Studies and Reports
ASEAN	Tsunami induced by the Sumatra earthquake on December 26, 2004 caused major damage to ASEAN countries. The disaster is summarized by organizations like ADB.
Thailand	There are a few recorded tsunami disasters in Thailand. The inundation area caused by the Sumatra earthquake on December 26, 2004 is summarized.

References for Data and Further Reading

1) ADB (2005). From Disaster to Reconstruction: A Report on ADB's Response to the Asian Tsunami
2) Asian Development Bank (2005): "From Disaster to Reconstruction: A Report on ADB's Response to the Asian Tsunami"
3) EM-DAT: The OFDA/CRED International Disaster Database – www.emdat.be – Université Catholique de Louvain – Brussels – Belgium.
4) Japan International Cooperation Agency (JICA) (2012): "Data Collection Survey on ASEAN Regional Collaboration in Disaster Management"

2.5 Volcanoes

Risks

There is no volcano in Thailand and also no record of significant disaster caused by volcanic eruption in its history.

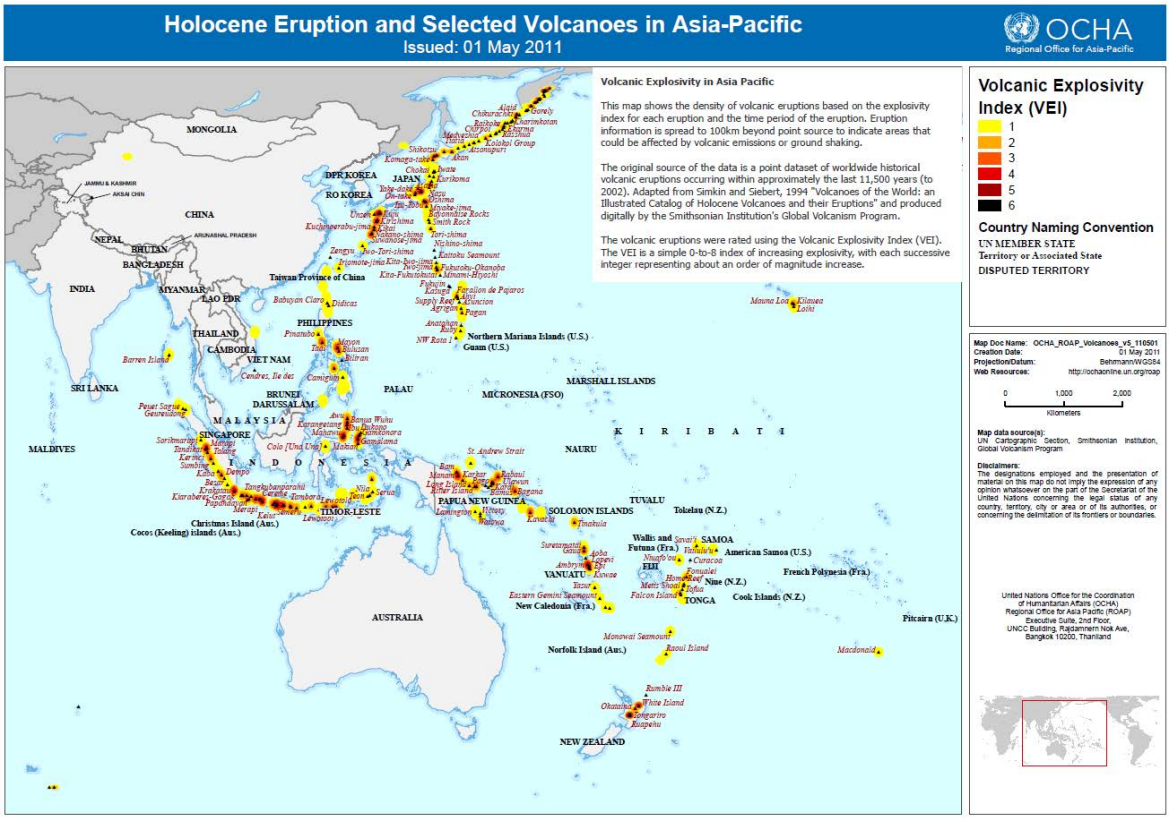
Background

Major hazards caused by volcanic eruption are lava flow, pyroclastic flow, “Lahar” (volcanic mud flow), and volcanic ash fall. Lava flow is a flow of melted rock along the slope. Pyroclastic flow is a flow of a mixture of hot dry masses of fragmented volcanic materials and volcanic gas along the slope. “Lahar” is originally an Indonesian term and is also called volcanic mud flow. It is a flow of a mixture of volcanic materials and water along the slope. These flows cause enormous damage to the side and foot of the volcano, but generally do not have an extended reach. However, volcanic ash fall often spreads widely via the trade winds or the westerlies, causing damage over an extensive area. Therefore, there is a possibility that a volcanic eruption in the neighboring countries might wreak a volcanic ash fall on Thailand.

Figure 2.9 shows the volcanoes in the Asia-Pacific region which erupted during the Holocene. The Holocene is a geological epoch from 10,000 years ago to the present. The map indicates that many volcanic eruptions have occurred in Indonesia, Philippines and other neighboring countries.

Responses by Thailand

There are no special measures focusing on volcanic disaster.



Source: OCHA

Figure 2.9 Holocene Eruption and Selected Volcanoes in Asia-Pacific

Reports on Hazard and/or Risk Assessment

Useful information and studies on volcanic hazard, risk, and vulnerability were collected from resources available in the public domain including websites. The information and studies include methodologies for analysis and assessment.

There is no standardized or authorized methodology for risk and vulnerability assessment. Therefore, methodology should be selected or updated in accordance with the purpose when risk and vulnerability assessment are required.

Locations of existing investigations and studies on volcanoes are shown in Figure 2.7. Outline of those investigations and studies are attached in Appendix 2 and their summary is given in Table 2.7.

Table 2.7 Summary of Existing Investigations and Studies: Volcano

Country/Region	Summary of Existing Studies and Reports
ASEAN	UNOCHA summarized the scale of the explosion of volcanoes around the Asia-Pacific region using the Volcanic Explosivity Index (VEI).
Thailand	There is no record of volcanic disaster in Thailand and no investigations or studies limited to this country and its regions were found.

References for Data and Further Reading

1) EM-DAT: The OFDA/CRED International Disaster Database – www.emdat.be – Université Catholique de Louvain – Brussels – Belgium.
2) Japan International Cooperation Agency (JICA) (2012): "Data Collection Survey on ASEAN Regional Collaboration in Disaster Management"
3) Lee Siebert, Tom Simkin, and Paul Kimberly (2011): "Volcanoes of the World - Third Edition", Smithsonian Institute/University of California Press
4) OCHA -ROAP (2011). Holocene Eruption and Selected Volcanoes in Asia-Pacific
5) United Nations Office for the Coordination of Humanitarian Affairs (OCHA), Regional Office for Asia Pacific (ROAP) (2011): "Holocene Eruption and Selected Volcanoes in Asia-Pacific", Downloaded from "http://reliefweb.int/sites/reliefweb.int/files/resources/map_619.pdf"

2.6 Cyclone and Meteorological Hazards

Risks

Thailand is located between latitudes 5° and 20° to the north and longitudes 97° and 105° to the east. This country is located in the tropical monsoon area. The northern part of the country is mountainous, covered by dense forests, and the central part of the country is covered predominantly by the flat Chao Phraya river valley, which runs into the Gulf of Thailand. The southern part of the country is the Malay Peninsula. The Peninsula is also located between two oceans, namely, the South China Sea (Gulf of Thailand) and the Andaman Sea. As a result, the country is susceptible to extreme weather such as droughts and floods due to El Niño and changes in the monsoon.

The climate of Thailand may be divided into three seasons - rainy season (southwest monsoon), dry season (northeast monsoon) and the pre-monsoon season. The average annual rainfall is approximately 1,200 to 1,600 mm. The monthly rainfall in September (200 to 300 mm) is the highest among all of the months. Some areas on the windward side, particularly, the Trat province in the eastern area and the Ranong province on the southern west coast, have more than 4,000 mm a year.

Tropical cyclones affecting Thailand usually move from the western North Pacific Ocean or the South China Sea. Thailand is normally affected by tropical depressions because of its location further inland. There are some mountain ranges, which obstruct and decrease wind speed, except in the southern area, which has a relatively high risk of tropical storms and typhoons. Tropical storms usually make landfall once every few years in Peninsular Malaysia in the south from the Gulf of Thailand or the South China Sea causing damage to the area.

Table 2.8 Tropical Cyclone (Storm) Disasters in Thailand (1980 - 2011)

Year (Month)	Typhoon, cyclone (name)	Killed	Total Affected
November 1989	Tropical Cyclone (Guy)	458	199,000
October 1997	Tropical Cyclone (Linda)	152	-
December 1981	Storm	55	-
September 1997	Tropical Cyclone (Sita)	46	50,394
August 1991	Tropical Cyclone	38	1,894,238
October 1990	Tropical Cyclone (Ira)	36	-
August 1995	Tropical Cyclone	27	-
August 2011	Tropical Cyclone (Nok-ten)	18	1,000,000
May 2004	Storm	13	5,050
September 1994	Tropical Cyclone (Hari)	10	-
September 2005	Tropical Cyclone (Damurei)	10	2,000

Data Sources:

EM-DAT, The OFDA/CRED International Disaster Database, Université catholique de Louvain, Brussels, Belgium: http://www.emdat.be.

Severe flooding occurred during the 2011 monsoon season in Thailand. Beginning at the end of July and triggered by the landfall of Tropical Storm Nock-ten, flooding soon spread through the provinces of northern, northeastern and central Thailand along the Mekong and Chao Phraya river basins. In October of the same year, floodwaters reached the mouth of the Chao Phraya and inundated parts of the capital city of Bangkok.

Flooding persisted in some areas until mid-January 2012 and resulted in a total of 815 deaths, 950 million affected people, and 45.7 billion US$ in economic damages and losses.

Table 2.9 shows the meteorological disasters in Thailand (1984~2013).

Table 2.9 Meteorological Disasters in Thailand (EMDAT: 1984 ~ 2013)

Cause	No. of events	Killed	Total Affected	Damage (millions US$)
Drought	8	-	29,982,602	424.3
Flood (including flash flood)	56	3,345	44,862,036	44295.4
Landslide	3	47	43,110	-
Storm	31	881	4,362,703	879.3
Forest fires	1	-	-	-

Background

The southwest monsoon brings warm and moist airstreams passing from the Indian Ocean towards Thailand in May. The first region affected is southern Thailand, especially the west coast of the peninsula. Later on, this wind moves to the central, north-eastern, and northern regions. Another factor causing rainfall during this period is the movement of the ITCZ. The ITCZ also arrives in May in the southern area, and then moves northward to Southern China around June to early July. In August, the ITCZ moves southward over northern and northeastern Thailand, and then over the central regions in September and the southern part by October. As a result, the most abundant amount of rainfall usually occurs from August to October for central Thailand, although the rainy season begins sometime in May.

Even though there are many tropical cyclones in the North West Pacific region, tropical cyclones are rare in the Gulf of Thailand. However, this infrequency increases the danger to people and properties. The tropical storm Harriet that came on shore at Laem Taloom Pook killed more than 900 people in 1962 and Typhoon Linda in 1997 killed more than 330 with 2,200 people missing.

Severe flooding occurred during the 2011 monsoon season in Thailand. In 2011, flash floods affected some areas of upper Thailand since mid-May. During late June following tropical depression Haima, Thailand experienced heavy rainfall in several areas, especially in the northern parts where flash floods and landslides were reported. In July, heavy rainfall occurred in many locations throughout the month caused the active southwest monsoon and monsoon trough, which lies across upper Thailand. Beginning at the end of July and triggered by the landfall of Tropical Storm Nock-ten, flooding soon spread through the provinces of northern, northeastern and central Thailand along the Mekong and Chao Phraya river basins. In October, floodwaters reached the mouth of the Chao Phraya and inundated parts of the capital city of Bangkok. Flooding persisted in some areas until mid-January 2012 and resulted in a total of 815 deaths (as of January 17, 2012) (with 3 missing) and 13.6 million people in 4 regions were affected. Sixty-five (65) of Thailand's 77 provinces were declared flood disaster zones and over 20,000 square kilometers (7,700 sq mi) of farmland were damaged. The disaster has been described as "the worst flooding yet in terms of the amount of water and people affected." The World Bank has estimated around 1,425

billion baht (US$ 45.7 Bn) in economic damages and losses due to flooding as of 1 December 2011. Most of the damage was to the manufacturing industry, as seven major industrial estates were inundated by as much as 3 meters (10 feet) during the floods.

Climate change vulnerability and impact in Thailand are as follows.

- In Thailand, observations during the last 50 years show temperature increases ranging from 0.10–0.18 °C per decade.
- Based on the climate data generated by the global circulation model, Thailand's temperature is projected to increase 2–4 ºC by the end of this century.

Responses by Thailand

Early Warning and Information Transmission

The National Disaster Warning Centre (NDWC) collects hydrological and meteorological data and provided early warnings.

The Thai Meteorological Department (TMD) issues routine weather forecasts, tropical cyclone warnings, aviation forecasts, and shipping and ocean wave forecasts. The types of forecast include very short (24 hours), middle range (7 days) and seasonal (three monthly forecast and summer forecast) forecasts.

The TMD uses operational numerical weather predictions with resolutions of 100 km for the entire globe, 50 km for Southeast Asia and 17 km for Thailand. The TMD has also provided daily wave analysis and 24-hour wave forecasting charts to the general public. Their domain covers the Gulf of Thailand, the Andaman Sea, and the South China Sea.

To strengthen monitoring of typhoons, the TMD have implemented the following.

- Enhancement of radar network to strengthen severe weather observations and monitoring networks and nowcasting of the country.
- Enhancement of the meteorological satellite data receiving station to monitor severe weather including typhoon and typhoon-related disasters.
- Improvement of storm surge forecasts.

Enhancement of the meteorological telecommunication network control system.

Sources of Hazard and Risk Information

Table 2.10 Sources of Hazard and Risk Information: Cyclone and Other Meteorological Hazards

Thai Meteorological Department (TMD)
http://www.tmd.go.th/en/

Table 2.11 Other Sources of Information: Cyclone and Other Meteorological Hazards

Institution	Literature name
Economy and Environment Program for Southeast Asia (2010)	Climate Change Vulnerability Mapping for Southeast Asia http://css.escwa.org.lb/sdpd/1338/d2-5a.pdf
UNISDR (2010)	Synthesis Report on Ten ASEAN Countries Disaster Risks Assessment http://www.unisdr.org/files/18872_asean.pdf

Reports on Hazard and/or Risk Assessment

"Cyclone" is a term to describe many types of low pressure systems, of which tropical cyclones/typhoons are the main types creating disasters in the ASEAN region. Under the framework of WMO, leading countries implement monitoring/detection of tropical cyclones on a regional basis. Table 2.12 indicates the responsible territory allocated to ASEAN members and its leading country.

Table 2.12 Members of WMO Tropical Cyclone Committee

	Warning Zones	Members (ASEAN)	Leading Country
Western North Pacific Ocean and South China Sea	0° - 60°(N) 0° - 100°(E)	Cambodia, Lao PDR, Malaysia, Philippines, Singapore, Thailand, Vietnam	Japan
Bay of Bengal and the Arabian Sea	5°S - 45°(N) 30°E - 90°(E)	Myanmar, Thailand	India
South Pacific and South-East Indian Ocean	0°-50°(S) 90° - 170°(E)	Indonesia	Fiji

The dates and information utilized in this report have been acquired from various reports on the studies and research conducted on tropical cyclones and meteorological hazards published on the internet. Collected documents include evaluation results of hazards/risks, as well as their evaluation methods. With regard to tropical cyclones/typhoons, a meteorological organization of each country compiles a summary on the damage situation, including the number of casualties or loss of human lives, and the estimated amount of damage, etc.

Locations of existing investigations and studies on cyclone and meteorological hazards are shown in Figure 2.10. Outline of those investigations and studies are attached in Appendix 2 and their summary is given in Table 2.13.

Figure2.10 Locations of Existing Investigations and Studies: Cyclone, Other Meteorological Hazards and Landslide

Table 2.13 Summary of Existing Investigations and Studies: Cyclone and Other Meteorological Hazards

Country/Region	Summary of Existing Studies and Reports
ASEAN	Study reports on natural disasters in the whole ASEAN region are available.
Thailand	Typhoons occurring between October and December and landing in central Vietnam can create damage that extends to Thailand. Abnormal weather due to the climate change has occurred.

References for Data and Further Reading

1) Edwin ST Lai (2013): "Overview of Member's Summary of Reports 2012, TC-45 Appendix VI - AWG Working Reports Members, WMO, p.24
2) ESCAP/WMO Typhoon Committee. (http://www.typhooncommittee.org/)
3) JMA/WMO Workshop on Quality Management in Surface, Climate and Upper-air Observations in RA II (Asia) 2011
4) Mekong River Commission (2011): “Flood Situation Report 2011”, MRC Technical Report Paper No.36 2011
5) “Natural Disasters 2011”, Climatological Center Bureau, 2011
6) Thai Meteorological Department (2011): “Rainfall and Severe flooding over Thailand on 2011”, http://www.tmd.go.th/en/event/flood_in_2011.pdf
7) Thai Meteorological Department (Website): http://www.tmd.go.th/en/
8) WMO National Meteorological or Hydrometeorological Services of Members (http://www.wmo.int/pages/members/members_en.html)
9) WMO (2010). First Meeting of the Task Team on “Meteorological, Hydrological and Climate Services for Improved Humanitarian Planning and Response”, WMO Headquarters, Geneva, Switzerland (31 August - 2 September, 2010)

2.7 Landslides

Risks

Locations of landslide disasters in Thailand are shown in Figure 2.11. Circle size represents the scale of the disaster in terms of human losses.

According to the EM-DAT database (http://www.emdat.be/), the recorded number of landslides is 14: however, landslides with fatalities have occurred every year since 2004 in Thailand. A large-scale debris flow hit Krabi province and Nakhonsithamrat province in 2011, causing 16 fatalities and losses amounting to over 10 billion THB.

It is assumed that there are landslide-prone areas in 6,450 villages among 51 provinces.[1)]

Landslides causing many fatalities occur in the mountainous area near the border with Myanmar and the southern part of Malay Peninsula.

Sources of Hazard and Risk Information

The 70-area hazard map for landslides has been issued by the Department of Mineral Resources (DMR; http://www.dmr.go.th/), and 190 areas are planned for addition in 2012.

An emergency survey on debris flow has been implemented by DMR per requests from provincial governments. Physical infrastructure for landslide prevention is quite uncommon.

Reports on Hazard and/or Risk Assessment

Locations of existing investigations and studies on landslides are shown in Figure 2.10. Outlines of those investigations and studies are shown in Appendix 2 and their summary is given in Table 2.14.

Data Sources:

EM-DAT, The OFDA/CRED International Disaster Database, Université catholique de Louvain, Brussels, Belgium: http://www.emdat.be.

Pacific Rim Coordination Center Disaster Data: http://data.pacificrimnetwork.org/.

Global Unique Disaster Identification Number: http://www.glidenumber.net/glide/public/search/search.jsp.

Figure 2.11 Location of Landslide Disasters in Thailand: Human Losses

Table 2.14 Summary of Existing Studies and Reports by Country: Landslide

Country/Region	Summary of Existing Studies and Reports
ASEAN	There have been a few reports that study landslides for ASEAN and the Pacific region at large in recent years. Disaster risks are assessed by scenario, exposure, vulnerability, damage, and loss. An assessment framework is also sought to give an overview of risks, hazard, and vulnerability.
Thailand	High levels of hazard are distributed in the border area with Laos, but there is no hazard in the lowland where the capital Bangkok and other main cities are located. Vulnerability indicated by occurrence of landslide and deaths is medium to low level. Exposure is distributed in a narrow area near the border with Myanmar. Large-scale hazard maps are being developed and an early warning system for flash floods is being prepared. Countermeasures for roadside slopes are also being conducted.

References for Data and Further Reading

1) Economy and Environment Program for Southeast Asia (EEPSEA) (2009): "Climate Change Vulnerability Mapping for Southeast Asia", p. 19
2) JICA(2012): "Data Collection Survey on ASEAN Regional Collaboration in Disaster Management : Country Report THAILAND", pp. 4-12
3) World Bank, UNISDR (2010). Synthesis Report on Ten ASEAN Countries Disaster Risks Assessment

3. Industrial Parks

3.1 Distribution of Industrial Parks in Thailand

87 industrial parks were identified by the study, and as shown in Figure 3.1, most of them are distributed in the lower part of the Central Plane and in the Eastern Seaboard. The rest are located in the North, Northeast and Southern Parts of Thailand.

A list of the industrial parks in Thailand is given in Appendix 3, and a brief description of the selected industrial parks is given in reference[2].

Thai industrial parks remain among the most attractive sites for foreign investors in ASEAN. Parks are generally very well managed and enjoy good infrastructure designed specifically to support foreign investors and exporters. They are also well connected to ports and airports. Most parks are also self-contained and offer a range of facilities, including accommodation for workers, one-stop investment services, and a range of amenities. Clear and detailed information on most parks is available online in at least two languages - Thai and English. Several parks also have Japanese language information. Park staff are helpful and often speak English or Japanese. They are happy to provide park information. The IEAT and BOI also have up-to-date information on parks in multiple languages, are responsive to investor enquiries and have English-speaking staff.

[2] AHA Centre and JICA (2014), Risk Assessment Reports for ASEAN and its Countries, Natural Disaster Risk Assessment and Area Business Continuity Plan Formulation for Industrial Areas in the ASEAN Region.

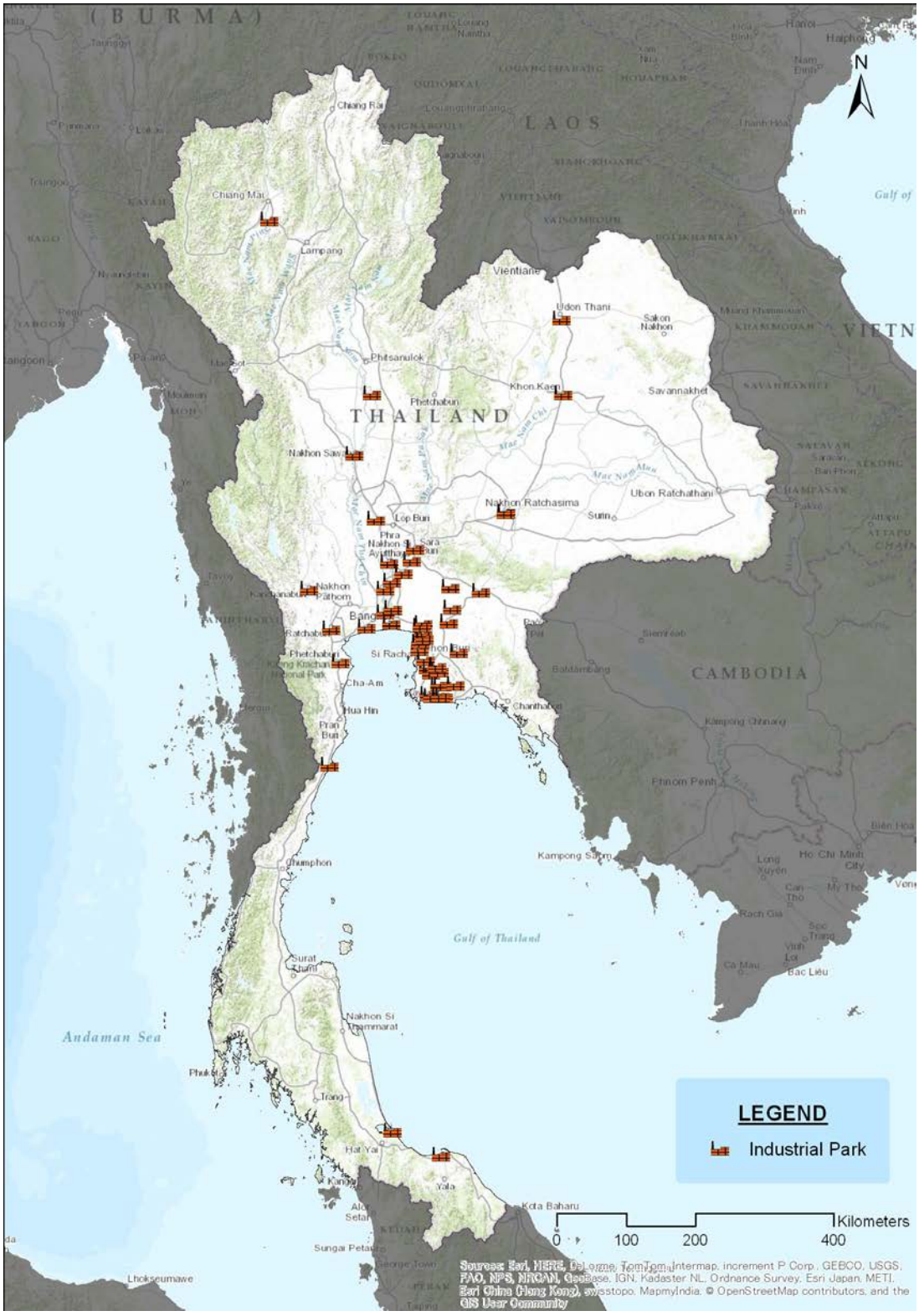


Figure 3.1 Distribution of Industrial Parks in Thailand

3.2 Historical Evolution of Industrial Parks

The development of industrial estates in Thailand began under the directive of the Ministry of Industry during the Thanom Kittikajorn government in the 1960s. Thailand officially began to pursue export-oriented development in 1966; however, it was very limited and restricted to certain types of agricultural products until the 1970s. In 1972, the Industrial Estate Authority of Thailand (IEAT) was set up as a state enterprise attached to the Ministry of Industry. It was responsible for implementing the government's industrial development policy, which included industrial estate development was an important part of state-directed industrialization. Key policies such as tax exemptions and various investment incentives began in the mid-1970s. In the early period of industrial development, industrial estates represented joint investment by the Thai state, overseas development assistance (mostly from Japan) and occasional private entities. Successive governments invested heavily in the building of infrastructure to attract and support foreign investment in industrial estates.

Since the 1970s, every successive Thai government has continued to pursue export-oriented development goals. The state has invested and encouraged the development of new industrial estates throughout Thailand, with the focus on the greater Bangkok area and the eastern coastal area (Eastern Sea Board). New roads, airports and sea ports were built to facilitate investment in industrial parks in these areas. Despite many episodes of political upheavals and the Asian Financial Crisis in 1997, every government has vowed to support further foreign investment, industry development and export-oriented manufacturing, resulting in high-level policy continuity. What has varied between governments are targeted industries. Since the government of Thaksin Shinawatra began in 2001, the Ministry of Industry and the Board of Investment (BOI) have set out to promote industries that have high domestic value add. Targeted industries include automobile and automobile parts, agro-industry, fashion/jewelry, and electronics. Joint ventures between the Thai state and private companies or private firms alone now account for the vast majority of growth of industrial estates in Thailand.

3.3 Recent Trends and Japanese Investment

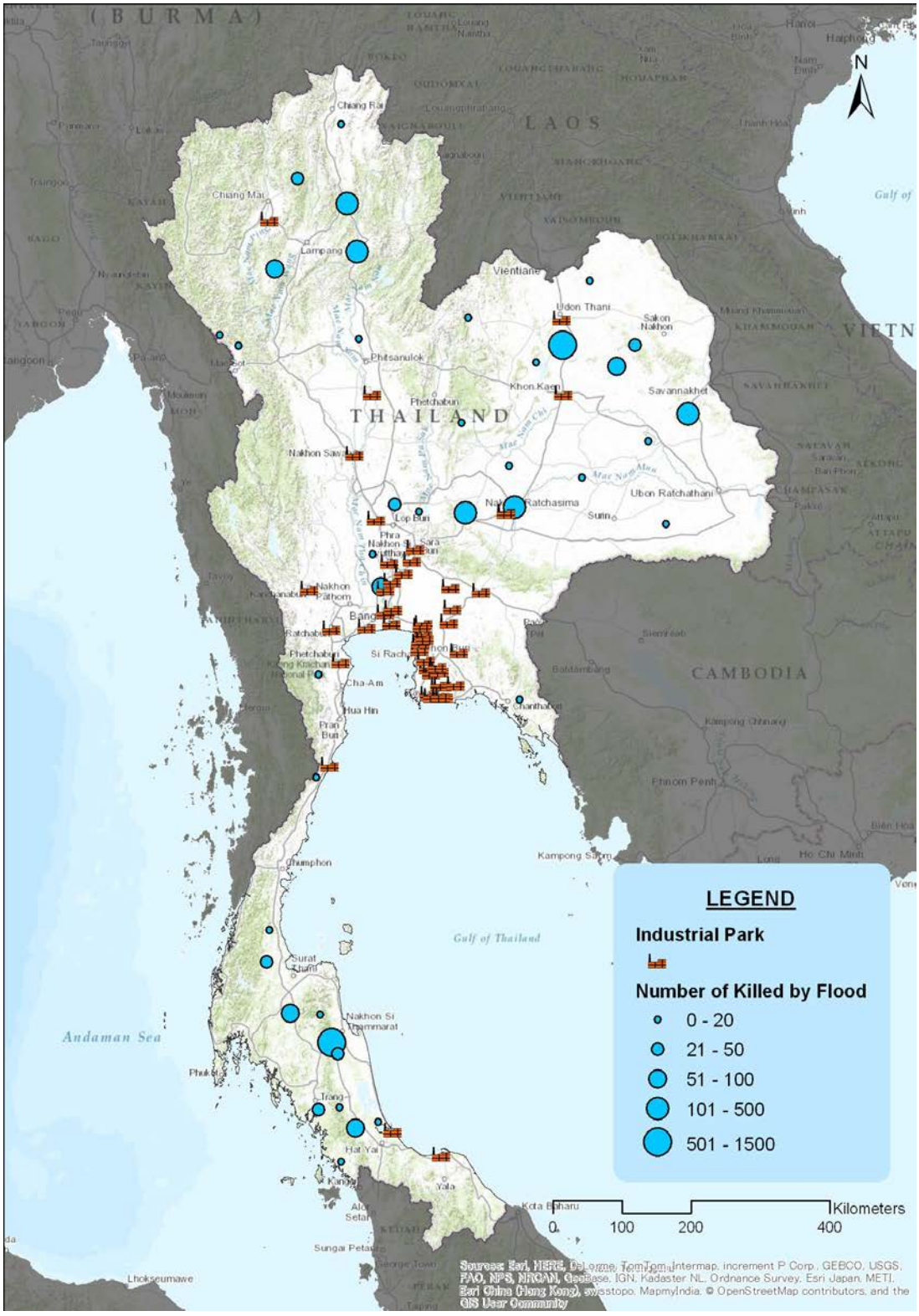
Japan has for some time been the largest investor in Thailand's industrial estates. This is no surprise given that the Japanese Bank of International Cooperation was crucial to the initial development of infrastructure and parks in Thailand. As of 2010, Japanese investment in Thai industrial parks accounted for 41% of total investment, followed by ASEAN at 38%. In some estates, such as Amata Nakorn, Japanese investment accounts for more than 60% of total investment. The significant presence of Japanese investment is beneficial for incoming Japanese investors, as the majority of Thai estates are familiar with supporting Japanese companies and provide tailored, high quality services.

The 2011 floods dealt a heavy blow to Japanese manufacturing companies, causing significant damage to more than 300 Japanese firms and disrupted their global supply chains. Government agencies are working to put flood control measures into place in flood-prone areas, but these efforts are unlikely to result in sufficient flood control capability for at least five years. As a result, industrial park operators are working to develop new estates in Thailand outside of flood-prone areas. We are aware of at least four such large developments in Prachinburi and Nakonnaiyok provinces. These new estates will have the added advantage of being close to the planned Greater Mekong Sub-region Southern Corridor Transportation Route that will connect to Vietnam and Myanmar. Parks in the Eastern Seaboard region are also likely to gain from the relocation of Japanese firms.

3.4 Risks of Natural Hazards

For the first glance of the risks of natural hazards to industrial parks and individual enterprises. it is useful to superimpose your location on the distribution maps of natural disasters given in Chapter 2. Figures 3.2 and 3.3 are examples showing relationships of locations of industrial parks and sites of flood disasters, presented by human losses and economic losses respectively. For the detailed assessment of the risks of natural disasters to industrial parks and individual enterprises, hazard and risk assessment are required for an area of interest.

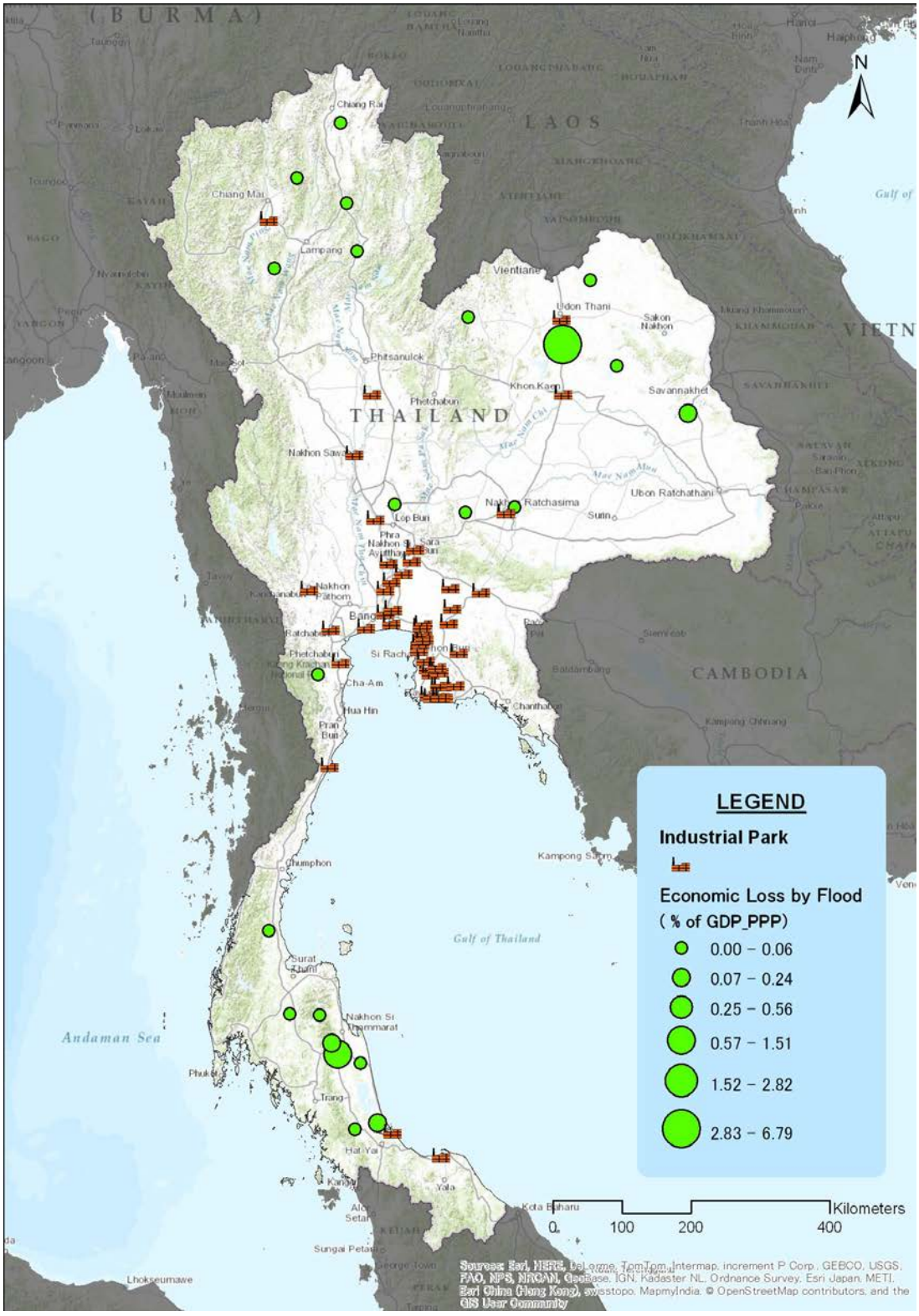
A description of general investment risks of Thailand is attached in Appendix 4.



Data Source:

EM-DAT, The OFDA/CRED International Disaster Database, Université catholique de Louvain, Brussels, Belgium: http://www.emdat.be.
Pacific Rim Coordination Center Disaster Data: http://data.pacificrimnetwork.org/.
Global Unique Disaster Identification Number: http://www.glidenumber.net/glide/public/search/search.jsp.

Figure 3.2 Industrial Parks and Flood Disasters: Human Losses



Data Sources:

EM-DAT, The OFDA/CRED International Disaster Database, Université catholique de Louvain, Brussels, Belgium: http://www.emdat.be.

Pacific Rim Coordination Center Disaster Data: http://data.pacificrimnetwork.org/.

Global Unique Disaster Identification Number: http://www.glidenumber.net/glide/public/search/search.jsp.

Figure 3.3 Industrial Parks and Flood Disasters: Economic Losses

4. Transport Infrastructure and Lifeline Utilities

4.1 Overview of Transport Infrastructure

Road

In Thailand, the road systems were developed at the beginning by the U.S. Army during the Vietnam War when their bases were located in Thailand. Now, the total length of motorways has grown to more than 67,000 km, and the pavement rate is more than 98%.

The Asian Highway, as an international trunk line, has nine (9) routes with a total length of 5,000 km in Thailand, all segments of which are more than 2-lane road and paved. These form a corridor of the Greater Mekong Subregion (GMS). A CCTV system has been installed along the main trunk roads in Bangkok to enable assessment of traffic conditions in real time.

The public roads in Thailand are categorized as shown below:

- National Highways (Primary, and Secondary National Highway)
- Provincial Highways
- Municipal City Roads
- Municipal Tambon Roads

Major road networks of Thailand are shown in Figure 4.1.

Railway

State Railway of Thailand

The railway in Thailand is a major means of transportation. There are four major railways (North railway, Northeastern railway, East railway, South railway), and the Mae Klong line, which is an independent railway section, and an airport railway link connecting with the airport. The operating distance is 4,071 km with almost all sections being a single track. The number of total passengers is 46,600 thousand. It is an important national transportation device.

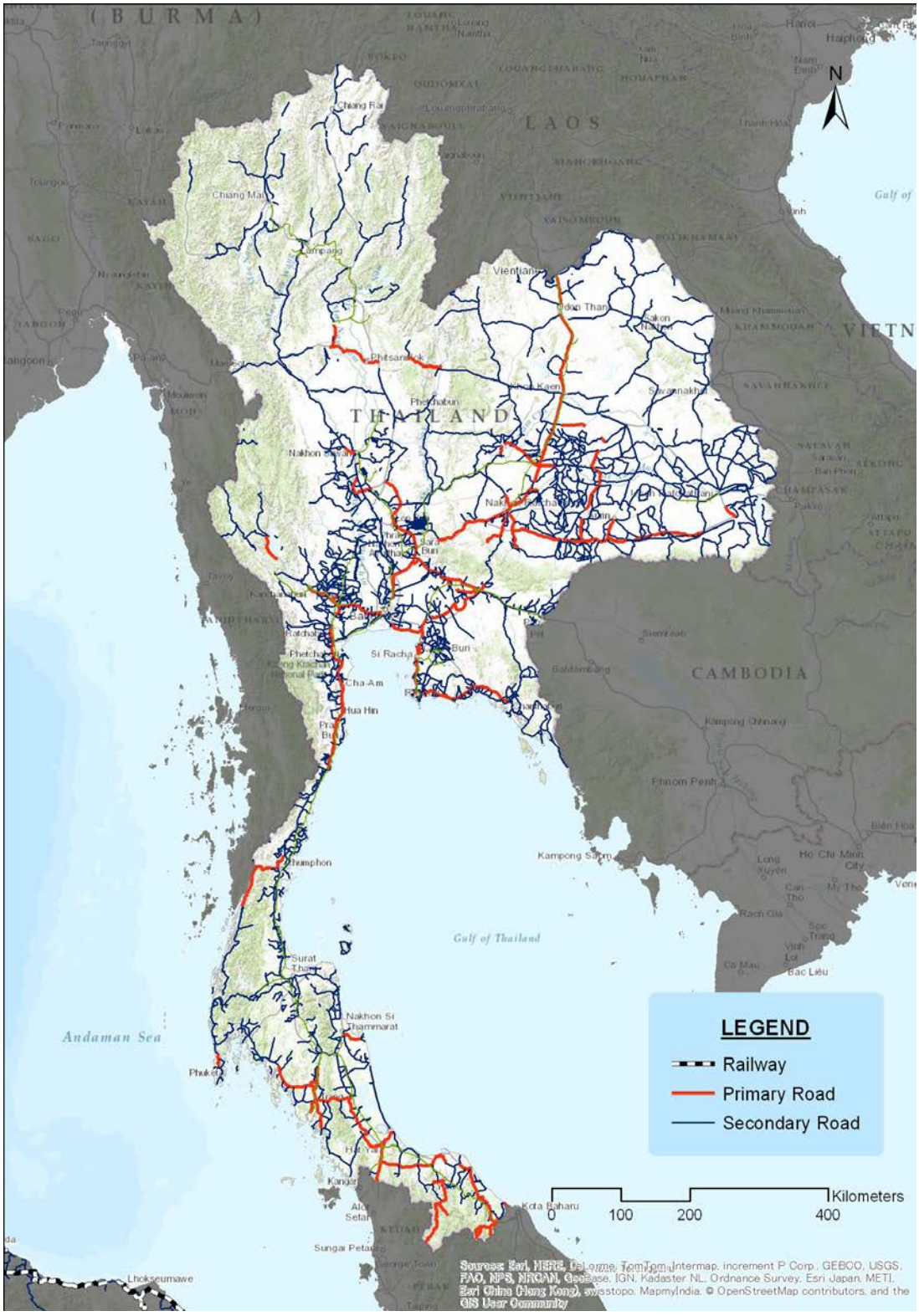


Figure 4.1 Major Road and Railway Networks of Thailand

There are freight trains for oil, cement, LPG exclusive freight trains, and export-and-import container traffic trains, etc.

Elevated Railway (BTS)

Elevated railway (BTS) (commonly known as Sky Train) and subway (MRT) have been introduced to improve the car-centered traffic system in Bangkok. The BTS started operations in December 1999. Currently, two lines, the Sukhumvit line and Si Lom line, are operating with a total length of 25.7 km.

Underground Railway

In addition to BTS, the first underground railway service started in July 2004. At the present, the line from Hua Lamphong station to Bang Sue station (20 km total distance) is operating.

Major railway networks are shown in Figure 4.1.

Port

Currently, there are five (5) major ports in Thailand. They are: Bangkok Port, Laem Chabang Port, KlongToey Port, Maptaphut Port, and Songkhla Port. These ports are operated and managed by the Port Authority of Thailand (PAT), which is established under the Ministry of Transport. Of these ports, the three (3) ports of Bangkok Port, Laem Chabang Port and Songkhla Port are included in the 47 ports designated by ASEAN.

Throughputs of these ports are shown in Table 4.1.

Table 4.1 Throughput of the three ports designated by ASESN 2008

Port Name	Throughput (Tons)
Bangkok	17,767,818
Laem Chabang	54,837,542
Songkhla	1,830,381

Source: ASEAN/ERIA, ASEAN Strategic Transport Plan 2011-2015

Locations of major ports are shown in Figure 4.2

Figure 4.2 Major Ports and Airports of Thailand

Airport

In Thailand there are seven (7) international airports: Suvarnabhumi, Don Muang, Chiang Mai, Chiang Rai, Hat Yai, Phuket, and Ko Samui.

The Thailand Airport Company (AOT) operates and manages six (6) of the international airports, not including Ko Samui.

Locations of major airports of Thailand are shown in Figure 4.2.

Table 4.2 Number of Services and Passengers at Thailand International Airports 2010.9

Airport Name	Passengers		Throughputs	
	(thousands)	(%)	(thousand tons)	(%)
Svarnabhumi	42,500	74.0	1,274	94.8
Phuket	6,800	11.8	26	1.9
Chaing Mai	3,180	5.5	21	1.5
Don Muang	2,760	4.8	7	0.5
Hat Yai	1,460	2.6	13	1.0
Chaing Rai	720	1.3	3	0.2
Total	57,430	100.0	1,343	100.0

Source: JBIC, Investment Environment in Thailand 2010.10

4.2 Overview of Lifeline Utilities

Electricity

The growth rate of electrical power in Thailand slowed greatly in both in 2008 and in 2009, but it recovered by 10% in 2010, and has been growing at an average of 6% since the beginning of the 21st century.

It is stable, though there are still about 1 or 2 momentary power failures per month.

The momentary power failures occur in 2 cases: one case occurs in the rainy season (June to October) and the other case occurs during the maximum power demand period (March to May). It recovers within less than one (1) hour and does not cause any big impacts.

According to the Electricity Generating Authority of Thailand (EGAT), about 70% of the electric power of Thailand depends on natural gas, and the share of the hydro-power generation is small.

When the oil platform of the Yadana Gas field in Myanmar, which supplies natural gas, stopped their operations for repairs in April 2013, it caused a large-scale electric power shortage.

Locations of major power stations and dams are shown in Figure 4.3.

Table 4.3 Rate of Produced Energy Source of Thailand 2010

Resources	Million kWh	Ratio (%)
Natural Gas	104,228	71.8
Coal-Fired Power	28,717	19.8
Hydro Power	6,964	4.8
Renewable Energy	2,116	1.5
Oil	607	0.4
Import Electricity	2,601	1.8
Total	145,233	100.0

Source: JBIC, Investment Environment in Thailand 2012.10

Water Supply

Although the public water service rate in Thailand is about 82% in urban areas (access rate is 96%), it is very low in farm villages.

However, communities have their own small-scale water services, superficially increasing water service rates. The length of the water supply pipeline is 106,500 km.

In Thailand, according to the Decentralization Promotion Law in 1999, it was decided that local government units should manage the water supply and sewage.

Waterworks Authorities are classified as follows:

- Metropolitan Waterworks Authority (MWA):

  The water supply target area is the Bangkok metropolitan area.

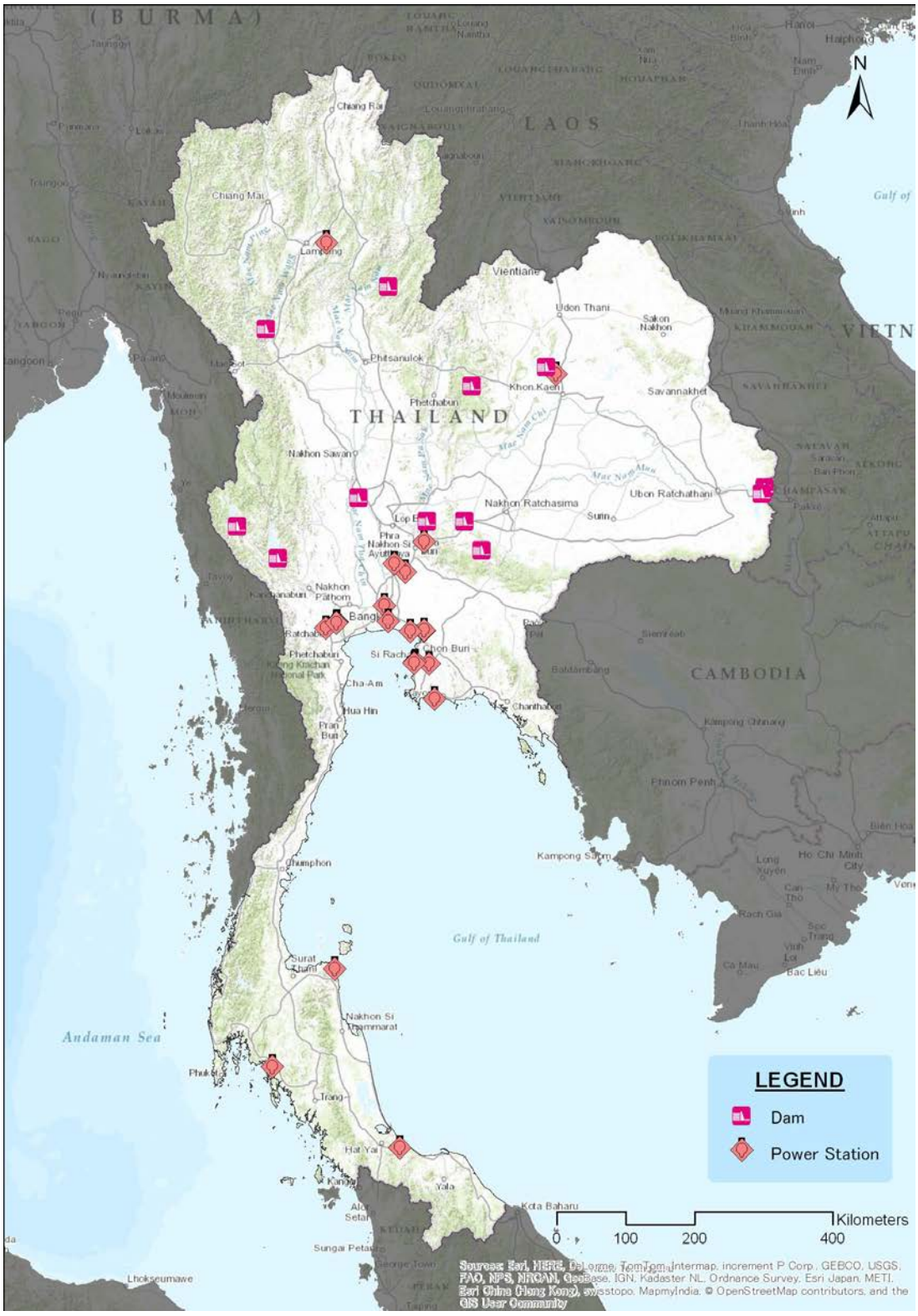


Figure 4.3 Major Power Stations and Dams of Thailand

- Provincial Waterworks Authority (PWA):

  The water supply target areas are the cities with a population of more than 5,000, not including the Bangkok metropolitan area.

- Others:

  The water supply target areas are the cities with a population of less than 5,000 and local government units with a population of more than 5,000.

Sewerage

Around the center of Bangkok metropolitan area, which is densely inhabited, river water is polluted by domestic waste water and industrial waste from the urban areas, aggravating water pollution.

The notification from the Ministry of Science, Technology and Environment (MOSTE) and an ordinance of the Bangkok Metropolitan Administration require the installation of septic tanks for building of a certain size or larger.

Although the construction of a sewage disposal plant has also started, the Wastewater Management Authority, which is responsible for it, does not fully demonstrate the work. The diffusion rate of the sewer network is 9.6%. However, although human waste is disposed of in septic tanks, raw sewage treatment efficiency is very low, causing river contamination. Thus, it is necessary to upgrade the raw sewage disposal capacity of the septic tank.

In Thailand, because the design of the sewage disposal plant is inappropriate, and the operation and management organization of each sewage disposal plant is unsatisfactory, many of the existing sewage disposal plants have not been functioning normally and are inefficient. For these reasons, the improvement of the efficiency at the existing sewage disposal plants in Thailand is an urgent need.

Communications

Internet and Broadband

There are 3.74 million subscribers with a diffusion rate of 5.4% as of 2011. The companies offering internet services are TOT, True Corporation, and TT&T.

WiFi connection services show a growing trend, and have been installed at about 40,000 places as of September 2011.

Mobile Phone

There are 78.67 million subscribers to mobile phone services as of 2011 with a diffusion rate of 113.2%, which exceeds one device per person. The main companies in the mobile communications field are AIS, DTAC, True Move, and CAT Telecom, with 3G services currently being mainstream.

Fixed-line Phone

There are 6.72 million subscribers to fixed-line phone services as of 2011, with a diffusion rate of 9.7%. The diffusion rate is very low and is decreasing yearly.

Broadcasting

Radio broadcasting companies include the state-run Radio Thailand, which is managed by NBT, the MCOT Radio Network (62 station), which is managed by the Mass Communication Organization of Thailand (MCTT), and more than 500 commercial broadcasting companies. There is also large number of army or community-related broadcasting stations.

In addition to the television broadcasting conducted by NBT, MOT, and Royal Thai Army Television, commercial broadcasters include the Bangkok Entertainment Channel and Bangkok Broadcasting & TV. TPBS is a public broadcasting company.

Waste

In Thailand systems regarding the disposal of hazardous waste have been developed; however, there is no law to manage waste disposal overall, including urban waste.

In 1992, the Enhancement and Conservation of National Environment Quality Act B.E. 2535 was enacted as a law relating to the environment. Although a system has been developed for hazardous waste processing management, there is no law to manages waste disposal overall, including city garbage.

Here, waste is broadly defined as "urban waste, dirt, wastewater, air pollutants, and solid/fluid/gas which contain toxic waste." Industrial waste was made the responsibility of municipalities by the Public Health Act of the same year.

The Enhancement and Conservation of National Environmental Quality Policy and Plan in 1996, established the following targets about general waste. (1997-2016)

- The amount of general waste shall be less than 1.0 kg per person per day.
- The recycling rate of waste in Bangkok and the municipalities throughout the country will be more than 15%.
- All the waste in municipalities should be managed, and the unprocessed waste in the outskirts of municipalities should be less than 10%.
- Each province shall formulate a master plan for hygienic management of general waste.

Fifteen (15) million tons of urban waste were generated in Thailand in 2008, and 12.9 million tons (equivalent to 86%) were collected. 4.3 million tons (27%) were disposed of by landfill dumping. As for the remainder, about 7 million tons was dumped illegally.

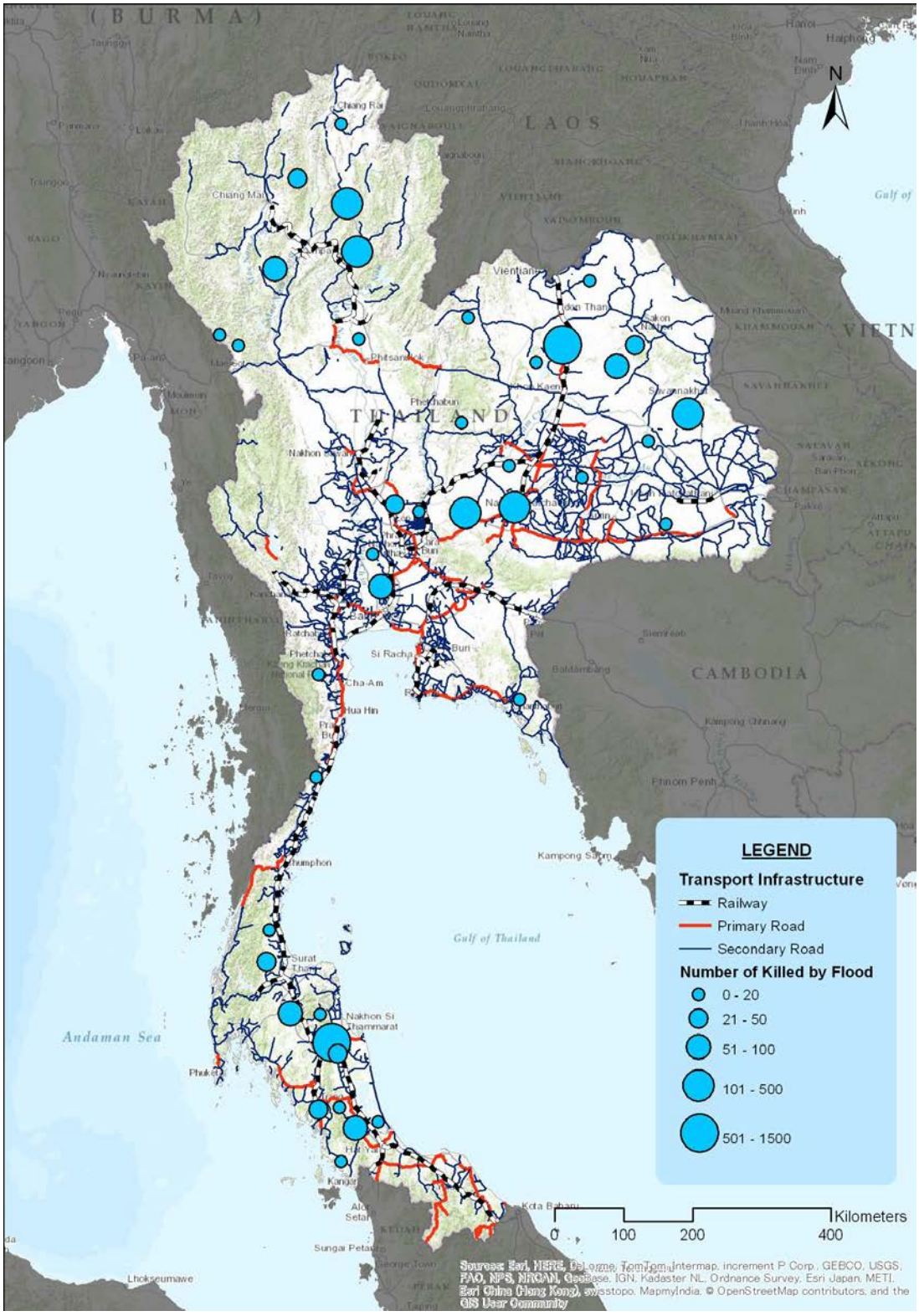
Although about 30% of general waste can be recycled, only about 70% of them were recycled.

The Pollution Control Department (PCD) is in charge of the management of waste.

4.3 Natural Disasters and Infrastructure

Since transport infrastructure and lifeline utilities have crucial for business continuity of enterprises, it is important to know their risks to natural disasters. For the first glance of the risks, it is useful superimpose locations of transport infrastructure and lifeline utilities on the distribution maps of natural disasters given in Chapter 2. Figures 4.4 and 4.5 are examples showing the relationships between flood disaster and road and railway systems, and between flood disaster and power plans and dams, respectively.

For the detailed assessment of the risks of natural disasters to transport infrastructure and lifeline utilities, hazard and risk assessment are required for an area of interest.



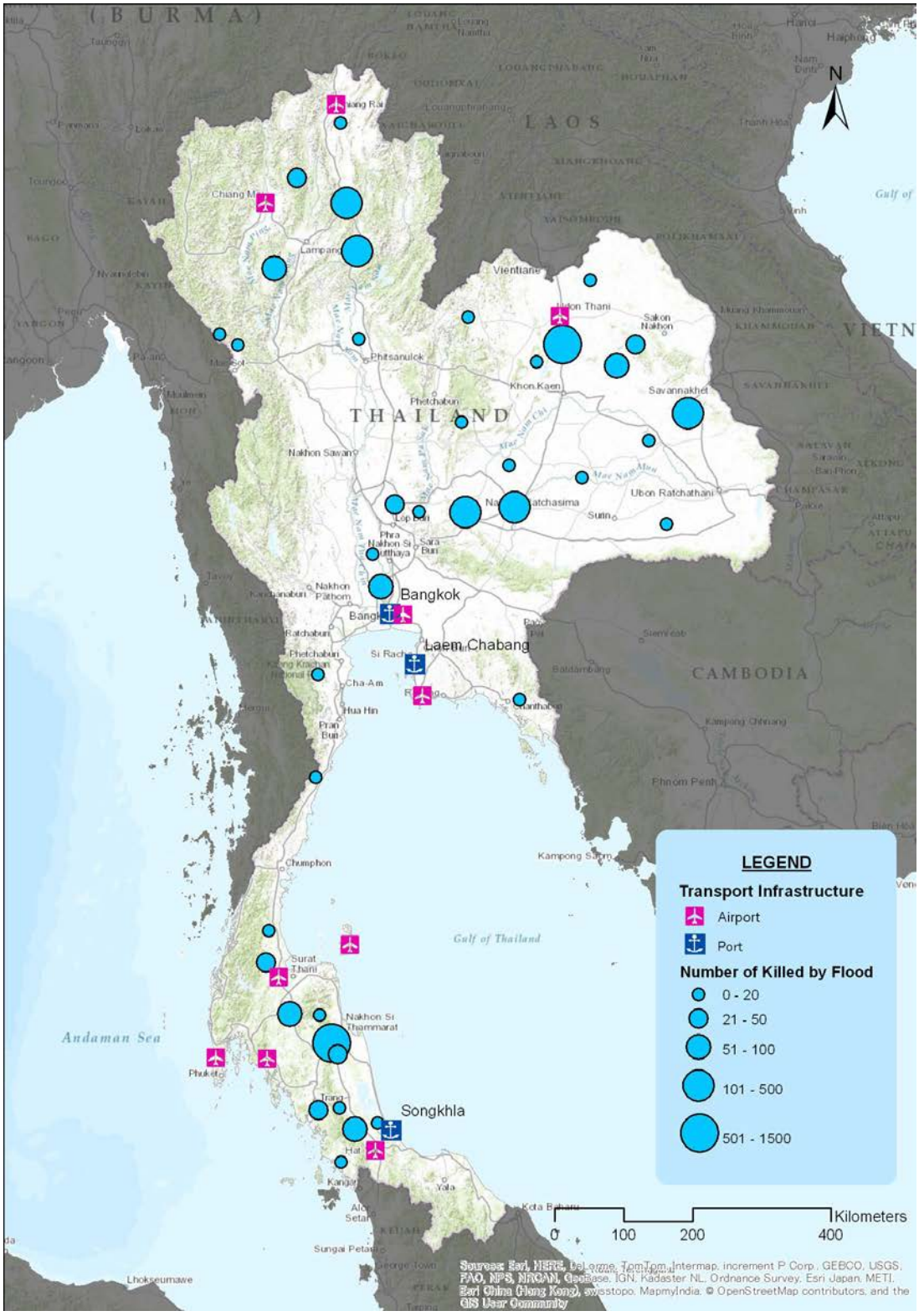
Data Source:

EM-DAT, The OFDA/CRED International Disaster Database, Université catholique de Louvain, Brussels, Belgium: http://www.emdat.be.

Pacific Rim Coordination Center Disaster Data: http://data.pacificrimnetwork.org/.

Global Unique Disaster Identification Number: http://www.glidenumber.net/glide/public/search/search.jsp.

Figure 4.4 Flood Disasters and Major Road and Railway Networks: Human Losses



Data Sources:

EM-DAT, The OFDA/CRED International Disaster Database, Université catholique de Louvain, Brussels, Belgium: http://www.emdat.be.
Pacific Rim Coordination Center Disaster Data: http://data.pacificrimnetwork.org/.
Global Unique Disaster Identification Number: http://www.glidenumber.net/glide/public/search/search.jsp.

Figure 4.5 Flood Disasters and Power Stations and Dams: Human Losse

5. Legislative Systems

5.1 Legislative Systems for Disaster Management

Disaster Management Laws

Table 5.1 Laws and Regulations of Disaster Management in Thailand

	Laws / Regulations	Supervisory Authority	Matter
Law	Disaster Prevention and Mitigation Act, 2007	NDPMC	Disaster Management

The Disaster Prevention and Mitigation Act was issued in 2007.

The flood disaster in 2011 provided an opportunity to review the policy. More solid prevention and mitigation measures are being considered.

Disaster Management Strategies and Plans

Table 5.2 Strategies and Plan for Disaster Management in Thailand

	Laws / Regulations	Supervisory Authority	Matter
Plan	National Civil Defense Plan 2005	DDPM	General Disasters
Plan	Strategic National Action Plan for Disaster Risk Reduction 2010-2019 (SNAP)	DDPM	General Disasters
Plan	National Disaster Prevention and Mitigation Plan 2010-2014 (NDPMP)	DDPM	General Disasters
Plan	Flood, storm, and landslide prevention master plan for natural disaster prevention and relief of affected people (2008-2012)	DDPM	Flood, Storm, Landslide

In 2010, the National Disaster Prevention and Mitigation Plan 2010-2014 (NDPMP) was established. The framework of the NDPMP is largely composed of i) management principle, ii) countermeasure procedure, and iii) security threat management & countermeasure procedure. It designates, as disaster countermeasure procedures, 14 disaster cases and the standing order for each of them. In addition, based on the NDPMP, it is expected that local DPMPs will also be prepared.

In light of the flood disaster event in 2011, a contingency plan is also planned for preparation in April 2012.

Moreover, the “Flood, storm and landslide prevention master plan for natural disaster prevention and relief of affected people (2008-2012)” was approved by the Cabinet.

5.2 Regulations and Standards for Business Continuity Management

Table 5.3 Regulations, Standards or Guidelines for BCM/BCP in Thailand

	Laws / Regulations	Supervisory Authority	Matter
Standard	TIS 22301-2553, Business Continuity Management Systems	Thai Industrial Standards Institute (TISI)	BCM
Guideline	118/2550 - Policy on BCM and BCP for Financial Institutions	Bank of Thailand	BCM

The Policy on BCM and BCP for Financial Institutions was developed for financial institutes in order to help them to enhance their preparedness for BCM and to establish a BCP. This policy statement briefly addresses directions and requirements for BCM / BCP, and procedures for a preparation of a BCP in banks are indicated. This includes, for example, the necessity of the identification of impacts from disruption of critical business functions and setting recovery time objectives in order to prepare the BCP.

Although in this statement, it is noted that the Contingency Plan for Information Technology policy statement was issued by Bank of Thailand in 2005, published information or documents has not been found. No documents of “TIS 22301-2553, Business Continuity Management Systems” have been verified.

5.3 Legislative Systems for the Environment and Pollution Control

Environmental Laws and Regulations

Table 5.4 Laws and Regulations regarding the Environment in Thailand

	Law / Regulations	Supervisory Authority	Matter
Law	Enhancement and Conservation of National Environmental Quality Act B.E.2535, 1992	The Minister of Science, Technology and Environment	Environment Management

The Enhancement and Conservation of National Environmental Quality Act B.E.2535 was established as an integrated law for environmental conservation in Thailand. The act describes the policy of public participation for the enhancement and conservation of environmental qualities, and also defines roles of agencies rerated to environmental pollution control.

Pollution Control Laws and Regulations

Table 5.5 Laws and Regulations for Environmental Pollution Control in Thailand

	Laws / Regulations	Supervisory Authority	Matter
Decree	Notification the Ministry of Science, Technology and Environment, No. 3, B.E.2539, 1996	Ministry of Science, Technology and Environment, Pollution Control Department	Industrial Effluent
Law	Factory Act B.E.2535	Ministry of Industry	Factory
Law	Hazardous Substance Act B.E.2535	Ministry of Industry, Department of Industrial Works	Industrial Waste
Law	Public Health Act B.E.2535, 1992	Ministry of Public Health	Environmental Pollution
Law	Public Cleansing Act B.E.2535, 1992	under survey	Environmental Pollution
Standard	Water Quality Standards, 2009	Pollution Control Department (PCD), Ministry of Natural Resources and Environment	Water Pollution
Standard	Air Quality and Noise Standards, 2007	PCD, Ministry of Natural Resources and Environment	Air Pollution
Standard	Soil Quality Standards, 2004	PCD, Ministry of Natural Resources and Environment	Soil Pollution
Plan	Pollution Prevention and Mitigation Policy in accordance with the Policy and Perspective Plan for Enhancement and Conservation of the National Environmental Quality 1997-2016 (1992)	PCD, Ministry of Natural Resources and Environment	Environmental Management

The regulations for control criteria of effluent from factories and industrial complexes are stipulated in the Notification the Ministry of Science, Technology and Environment, No. 3, B.E.2539, 1996. In addition, the Factory Act and the Hazardous Substance Act were developed in order to prescribe rules regarding industrial pollution.

Criteria for controlling pollution that threatens human health are described in the Public Health Act B.E2535, and the implementation of public cleaning by the Pollution Control Department (PCD) is stipulated in the Public Cleansing Act B.E.2535.

There are several standards regulating the conservation of water, air, and soil quality, in which the standard values of contamination and methods for analysis are prescribed.

5.4 Legislative Systems for Development including Land Use, Rivers, and Building Code in Thailand

Table 5.6 Laws and Regulations for Land, Rivers, and Building Code in Thailand

	Laws / Regulations	Supervisory Authority	Matter
Law	Land Readjustment Act B.E.2547	under survey	Land Use
Law	National Reserve Forest Act, 1964	under survey	Forestry
Law	Groundwater Act B.E. 2520, 1977	under survey	Water Resources
Law	Building Control Act, 1979	under survey	Building Standards

In Thailand, regulations related to land use and development are established as the Land Readjustment Act B.E.2547 and the National Reserve Forest Act, 1964.

No information or published documents about the Building Control Act have been verified.

6. Implementation of BCP

Guideline for the development of BCP among the financial institutes such as banking companies is established by the financial authorities in Thailand. However, any regulations or guidelines for BCM/BCP in industrial companies have not been developed.

Information about the actual condition of development of BCP and effort to disperse the BCP among companies are not sufficiently disclosed in the internet. The on-site surveys and interviews of institutions concerned are required.

Appendix 1: Method for Evaluating Predominant Hazards

The "Damage Amount / GDP" and 'Number of Deaths" are used as the indices to show the impacts of the disasters considered and 6 natural hazards will be studied and compared. At the beginning of the study, only the "Damage Amount / GDP" was used as an index because the results can be used for Area BCP planning. However, the scarcity of information related to damage amounts became clear as the study progressed. As the information on the "Number of Deaths" is substantial compared to the damage amount, the "Number of Deaths" has been added as an index of impact.

The process of the study is as follows;

1) Based on the Damage Amount / GDP or Number of Death, each disaster is classified according to the ranking system outlined in Table
2) The number of disaster events for each country is added by type of hazard and disaster rank, and then classified into

Table **A2** below,

3) The above information is then plotted on the impacts - frequency matrix by country,
4) As for earthquakes, tsunamis and volcanic hazards, if an event occurred before 1983 that was of the same (or higher) disaster rank as the maximum disaster rank recorded between 1983 to 2012, a point is plotted on the matrix which corresponds to the relevant disaster and frequency rank (=1).

Table A1 Disaster Rank and Damage

Disaster Rank	Damage Amount / GDP[3]	Number of Death
5	1.0% -	10,001 -
4	0.1% - 1.0%	1,001 - 10,000
3	0.01% - 0.1%	101 - 1,000
2	0.001% - 0.01%	11 - 100

[3] Gross domestic product based on purchasing-power-parity (PPP) valuation of country GDP, International Monetary Fund, World Economic Outlook Database, October 2012

1	- 0.001%	- 10

Table A2 Frequency Rank and Number of Events

Frequency Rank	Number of Events from 1983 to 2012	Average Frequency (Events / Year)
5	7 or more	1/5 -
4	4 to 6	1/10 - 1/5
3	2 to 3	1/15 - 1/10
2	1	1/30
1	Large Events occurred before 1983	-

Appendix 2:
Data Sheets
Outline of Existing Investigations and Studies

No.:	FL-001	Published Year:	2010
Study/ Report Name:	Synthesis Report on Ten ASEAN Countries Disaster Risks Assessment		
Access to Information:	www.unisdr.org/files/18872_asean.pdf		
Research Organization:	UNISDR/World Bank		
Study Area (Country):	ASEAN (10 countries)		
Studied Hazard:	Flood		
Studied Damage/ Risk:	Flood		
Main Data Sources:	CRED EM-DAT, ADRC, NGDC, GSHAP, MRC, WAMIS, DWR, Munich Re, World Bank, UNISDR, GAR, In Terragate, IFNet, CCFSC, DESINVENTAR		

Summary of the Study:

1) Overview

Disaster risks are assessed for years (1970-2009) by 1) Scenario, Exposure, Vulnerability, Damage and Loss analysis using existing database. The dominant disaster risks are cyclonic storms (typhoons), earthquakes, tsunamis, floods, epidemics, landslides, droughts volcanic eruptions and forest-fires. In total 1,211 reported disasters caused over 414,900 deaths.

2) Vulnerability

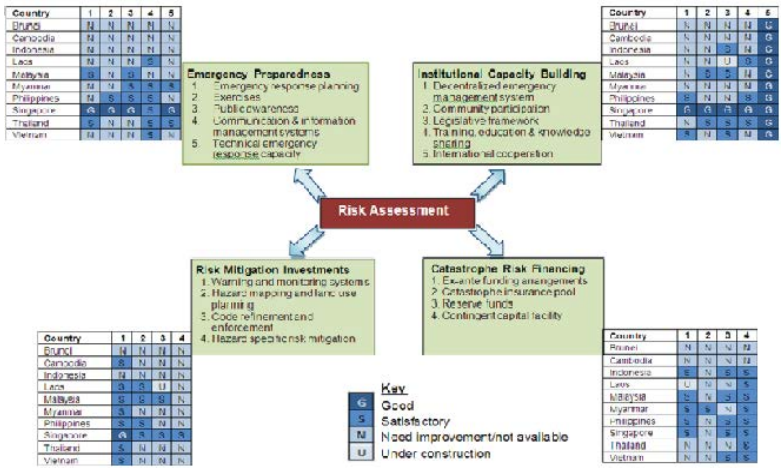
Method: the number of disaster events, deaths, affected population and economic losses are plotted against hazard types for 5 year intervals.

To estimate social vulnerability=> the average number of people killed.

ASEAN 17.7 death/year/million, Cambodia 3.56, Indonesia 20.38, Lao PDR 4.22, Malaysia 1.26, Myanmar 72.35, Philippines 11.93, Thailand4.63, Vietnam 4.60. Brunei and Singapore have no data.

3) Risk assessment framework

A status of risk assessment framework is assessed by country to view the current capacity of risk assessment. The evaluation table is show below.



No.:	FL-002	Published Year:	2012
Study/ Report Name:	Key Indicators for Asia and the Pacific 2012 43rd edition		
Access to Information:	www.adb.org/publications/key-indicators-asia-and-pacific-2012		
Research Organization:	ADB		
Study Area (Country):	ASEAN (10 countries)		
Studied Hazard:	Flood		
Studied Damage/ Risk:	Vulnerability by % population and area		
Main Data Sources:			

Summary of the Study:

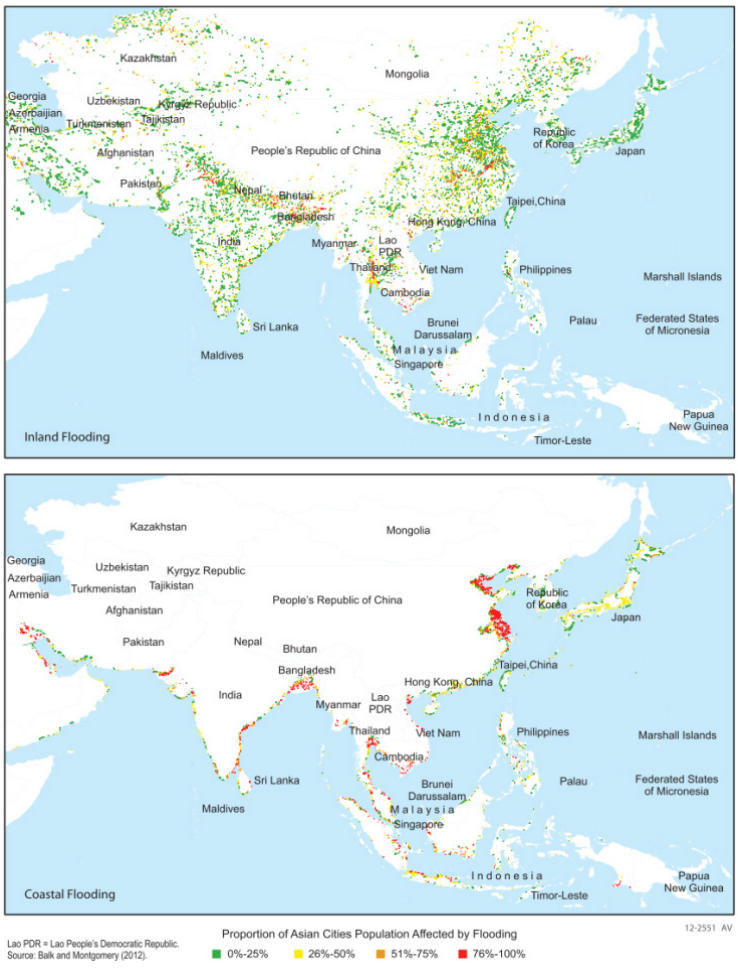
This report summarizes vulnerability of urban cities to flood in Asian and Pacific counties including the ASEAN region. The floods are classified as coastal flood and inland flood that may affect urban cities. Vulnerabilities are estimated by population and areas % at risk of flooding. Top 40 cities in Asian countries with 1 million population or more that are vulnerable to flooding are listed.

Key findings:

The Southeast Asia (ASEAN) region's vulnerability to coastal flooding: 36.1% with Vietnam (73.9%), Thailand (60%).

In terms of inland flooding, the vulnerability for Southeast Asia is 14.7%. The estimated vulnerability: Vietnam (38.6%), the Lao PDR (34%), Thailand (29%).

Figure 19 **Vulnerability to Inland (top) and Coastal (bottom) Flooding**



No.:	FL-003	Published Year:	2010
Study/ Report Name:	Progress Report on Flood Hazard Mapping in Asian Countries ICHARM Publication No.16, ISSN 0386-5878/ Technical Note of PWRI No. 4164		
Access to Information:	http://www.icharm.pwri.go.jp/publication/pdf/2010/4164_progress_report_on_fhm.pdf		
Research Organization:	UNESCO (ICHARM)/PERI		
Study Area (Country):	ASEAN (10 countries)		
Studied Hazard:	Flood		
Studied Damage/ Risk:	Hazard Map		
Main Data Sources:			

Summary of the Study:

1) Overview

This is a seminar report on Flood Hazard Mapping production process for Asian Countries. Target countries were (China, Cambodia, Indonesia, Laos, Vietnam, Thailand, the Philippines, Malaysia).

2) Accuracy of Hazard Map

Two types of mapping methods are: i) interview based mapping (community-based), ii) quantitative hydrological data simulation models.

For the local usage, a simpler version is also effective. Examples of practical hazard maps are demonstrated as follows.

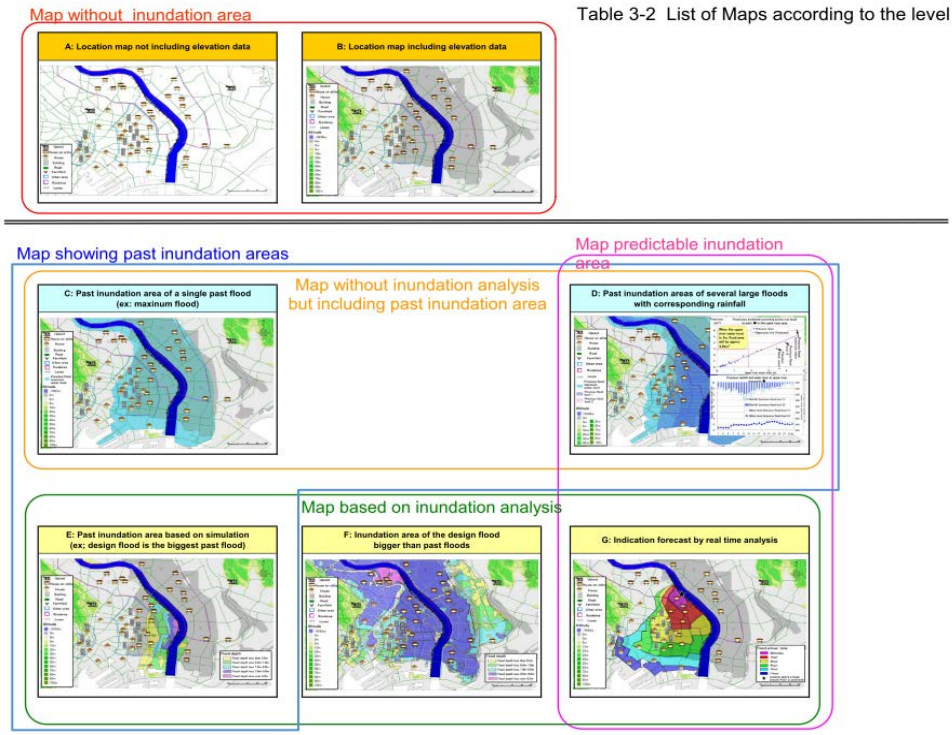


Table 3-2 List of Maps according to the level

No.:	FL-004	Published Year:	2005
Study/ Report Name:	A Primer: Integrated Flood Risk Management in Asia 2		
Access to Information:	www.adpc.net/maininforesource/udrm/floodprimer.pdf		
Research Organization:	Asian Disaster Preparedness Center (ADPC)/UNICEF		
Study Area (Country):	Asia including ASEAN countries		
Studied Hazard:	Flood		
Studied Damage/ Risk:	Assessment method		
Main Data Sources:			

Summary of the Study:

This is a comprehensive and practical how-to-handbook for policy makers and implementation stakeholders of flood risk management in Asia, with updated resources to (1) authorize programs; (2) formulate decisions; (3) plan, develop and implement decisions; (4) support implementation of decisions. There are extensive glossaries of words and concepts in relation to flood risk management.

Topics include:

Chapter 2: Types and levels of flood: riverine flood, slow-onset, rapid-onset, normal flood (1 year flood), catastrophic flood (100 year flood). Causes of flood: meteological, hydrological and anthropogenic.

Chapter 3: Policies, legal and institutional arrangement plans:

Chapter 4: Flood risk assessment, data required for an assessment of potential damages and losses, Flood frequency calculations

Chapter 5: Importance of watershed and floodplain management for flood risk management

Chapter 6: Structural interventions: flood storage reservoir, dykes, levee and embankment, EIA, cost benefit analysis

Chapter 7: Flood-proofing measures, relocation, elevation, dry-flood proofing, wet-flood proofing, flood-proofing measures categories: permanent, contingent and emergency measures

Chapter 8: Flood preparedness planning: preparedness framework, activities, flood forecasting, public awareness

Chapter 9: Effective emergency response in environment healthe management, evacuation camps, delivery of goods

Case studies of ASEAN countries include:

Disaster Management and Relief in Malaysia,

Hazard Assessment in the Philippines,

Flood mitigation mix measures/community level management in Thailand,

Mekong River Commission Mediation of Transboundary Flood Issues

No.:	FL-005	Published Year:	2009
Study/ Report Name:	Climate Change Vulnerability Mapping for Southeast Asia		
Access to Information:	http://web.idrc.ca/uploads/user-S/12324196651Mapping_Report.pdf		
Research Organization:	Economy and Environment Program for Southeast Asia (EEPSEA)		
Study Area (Country):	ASEAN (Thailand, Vietnam, Laos, Cambodia, Indonesia, Malaysia, and Philippines)		
Studied Hazard:	Flood		
Studied Damage/ Risk:	Vulnerability to climate change, flood frequency		
Main Data Sources:	Urban Extent Database (GRUMP version 1) of the (CIESIN) GEODATA portal (the Environmental Database; http://geodata.grid.unep.ch/extras/datasetlist.php) BAKOSURTANAL		

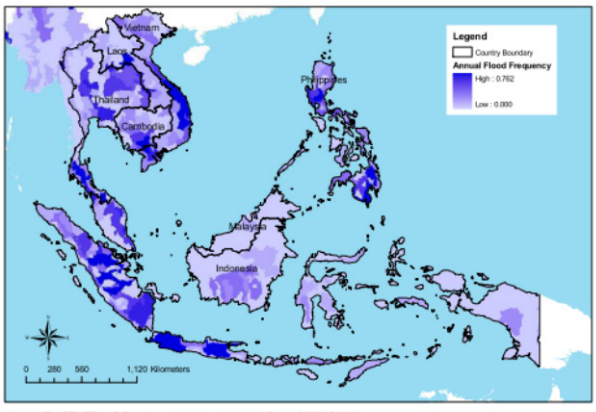
Summary of the Study:

1) Overview

This study assesses vulnerability of Southeast Asian countries (Thailand, Vietnam, Laos, Cambodia, Indonesia, Malaysia, and Philippines) of climate change including flooding. Vulnerability is defined as a function of exposure (potential loss due to a hazard), sensitivity (the potential gravity of losses and damage), and adaptive capacity (how much to adapt a hazard situation).

2) Vulnerability assessment

Vulnerability is assessed by adaptive capacity (HDI, PPP, Gini-coefficient, Education, road, electricity…), population density (human sensitivity) and hazard map (hazard occurrence frequency data from 1980-2000). Adaptive capacity influences vulnerability. When adaptive capacity is low, vulnerability is high.



Appendix 2B. Flood frequency (event per year from 1980-2001)

3) Area analysis

Cambodia is among the most vulnerable in ASEAN despite its relatively low exposure to climate hazards. The eastern coast of Vietnam is susceptible to cyclones, but adaptive capacity is high to manage to moderate its vulnerability. Bangkok and Jakarta have high adaptive capacities but not enough to moderate their extreme vulnerability with high population densities and significant exposure to climate hazards. A map shows annual flood frequency of the region.

No.:	FL-006	Published Year:	2012
Study/ Report Name:	Reducing Vulnerability and Exposure to Disasters The Asia-Pacific Disaster Report 2012		
Access to Information:	http://www.unisdr.org/we/inform/publications/29288		
Research Organization:	ESCAP/UNISDR		
Study Area (Country):	ASEAN (10 countries)		
Studied Hazard:	Hydro-meteolological Hazard		
Studied Damage/ Risk:	Economic losses, fatalities, houses, risk-sensitive plans of investment		
Main Data Sources:			

Summary of the Study:

1) Overview

The Asia-Pacific region represents 75% of all global disaster fatalities. The economic and population growth contribute to a greater exposure to natural disasters. The population was doubled from 2.2 to 4.2 billion between 1970 and 2010. But the number of people who are exposed to flooding has increased from 29.5 to 63.8 million. The urban settlements are more vulnerable as the urban population increased from 17 to 44% of the total population between 1950 and 2010.

2) Vulnerability

Generally, smaller and less diversified economies are more vulnerable to disaster risks. Flood mortality risks are higher in rural areas with a densely concentrated and rapidly growing population with weak governance.

3) Risk

Risks are associated with economic and mortality risks. The exposure to flooding events constantly increases as of 1980 but mortality risks are decreasing as countries strengthened their risk governance capacities. However economic risks are increasing, due to slow adaptation of the existing fixed assets, such as old buildings and infrastructure, and institutional instruments such as land use planning and building regulation to cope with flooding particularly in rapidly urbanizing areas.

4) Spatial and land use plan

The national spatial and land use plans and policies are a key to reduce flood risks. Brunei, Indonesia, Lao PDR, Malaysia, Philippines, Singapore and Vietnam have land-use policies, plans or measures for DRR.

No.:	FL-008	Published Year:	2011
Study/ Report Name:	Advancing Disaster Risk Financing and Insurance in ASEAN Countries: Framework and Options for Implementation, Volume2: Appendix 1		
Access to Information:	https://www.gfdrr.org/sites/gfdrr.org/files/documents/DRFI_ASEAN_ Appendices_June12.pdf		
Research Organization:	GFDRR/World Bank		
Study Area (Country):	ASEAN (10 countries)		
Studied Hazard:	Flood (multiple disasters)		
Studied Damage/ Risk:	Damage, affected population, vulnerability index		
Main Data Sources:	World Bank, EM-DAT, Relief Web, GFDRR, CIA fact book		

Summary of the Study:

1) Overview

Disaster risks were compiled for ASEAN countries with data between 1982 and 2011. The following items are analyzed: disaster profile (% of different disasters), damage ($), affected population, vulnerability index (estimated number of people killed/year).

2) Disaster profile: Typhoon is the dominant incidence causing flood and landslide in most countries except Singapore and Brunei

Cambodia: 45% flood (Mekong river), 9% storm, 16% drought, 29% epidemic

Indonesia: west and dry zones most severely hit (Jakarta, Medan, Bandug)

Lao PDR: 50% flood, 22% epidemics, 13% storm, 13% drought

Malaysia: dominantly flood

Myanmar: multiple hazards, earthquake serious risk

Philippines: dominantly typhoons causing other hazards in conjunction

Thailand: multiple hazard (flood, drought, storms and landslide)

Vietnam: 49% storm, 37% floods, 5% epidemic, 3% landslide, 2% drought

3) Vulnerable areas

Mekong River Delta in Vietnam, all regions of the Philippines, most regions in Cambodia, North ad East Lao PDR, Bangkok in Thailand, the west and south of Sumatra and western and eastern Java in Indonesia.

4) Vulnerability

Urban (especially coastal) areas are more vulnerable against disasters due to a rapid population growth, urbanization, deforestation, and unplanned land use.

No.:	FL-017	Published Year:	2004
Study/ Report Name:	Assessment of flood risk in Hat Yai Municipality, Southern Thailand, using GIS		
Access to Information:	http://jsnds.sakura.ne.jp/contents/jnds/26_1_1.pdf		
Research Organization:	Journal of Natural Disaster Science		
Study Area (Country):	Thailand, Hat Yai in the Khlong U-Taphao Basin		
Studied Hazard:	Flood		
Studied Damage/ Risk:	Physical damage, financial damage		
Main Data Sources:	Royal Thai Survey Dept., GISDA, Office of Environmental Policy ad Planning, Hat Yai Municipality, Meteorological Dept., Dept. of Public Works and Town & County Planning, Dept. of Provincial Administration, Community		

Summary of the Study:

1) Overview

This report assesses flood hazard and risk in Hat Yai Municipality, comprising 33 communities, covers an area of 20.1 km2 and has a population of 157,876 people.

2) Cause of flooding

The cause of vulnerability to floods is deforestation. From 1982 to 2002, forest resources decreased from 48,281 to 26,781 hectares, equivalent to a reduction of 44.5 %. Hat Yai Municipality experienced two flood events of catastrophic magnitudes in 1988 and 2000.

3) Risk Assessment Result

Susceptibility	Very low	low	moderate	High	very high
Flood hazards (ha)	99.0	400.0	1110.0	346.0	100.0
Flood risks (ha)	39.6	654.6	152.7	664.5	543.6

Factors to assess the susceptibility are as follows.

For flood hazard: rainfall, elevation, slope, drainage, road, land use are considered.

For flood risk: flood hazard, population, land use types are considered.

All the residential, commercial, industrial, and the public utilities and facilities areas, equivalent to 1,188.0 ha (57.8 %) of the municipality's total land area, faced high and very high flood risks. Complete prevention of floods with structural measures is impossible and uneconomical. Non-structural measures are needed to supplement structural mitigation and prevention measures. Ways to reduce flooding risks: 1) decreasing hazards, 2) reducing or eliminating the vulnerability of the elements at risk, or a combination of both actions.

No.:	FL-018	Published Year:	2011
Study/ Report Name:	Thailand Flooding 2554 Rapid Assessment for Resilient Recovery and Reconstruction Planning		
Access to Information:	http://www.nesdb.go.th/Portals/0/news/nesdbnews/flood/Post%20Disaster%20Needs%20Assessment.pdf		
Research Organization:	World Bank		
Study Area (Country):	Thailand, Chao Phraya river		
Studied Hazard:	Flood		
Studied Damage/ Risk:	Physical damage, financial damage		
Main Data Sources:			

Summary of the Study:

1) Overview

The focus of the PDNA report is to estimate monetary damages and losses of the flood 2011. The total damages and losses are THB 1.44 trillion (USD 48 billion) for a five year period.

2) Assessment area

The data collected from: 18 social and economic sectors and cross-cutting issues from affected 26 provinces

A social impact assessment conducted in: 3 provinces, Lopburi, Uthaithani and Nakonsawan provinces in the Central Plains

3) Damages

80 percent of the rehabilitation needs is from the manufacturing sector. This is the largest damages throughout sectors. The economic impact is concentrated in the 7 industrial estates.

Rehabilitation needs: Public sector Bt389billion, Private sector Bt1,055billion

Rehabilitation cost % of post flood government revenue: 126.6 billion Bt (2012: 6.3%), 200.6 billion Bt (2013: 8.8%), 61.2 billion Bt (2014: 2.4%)

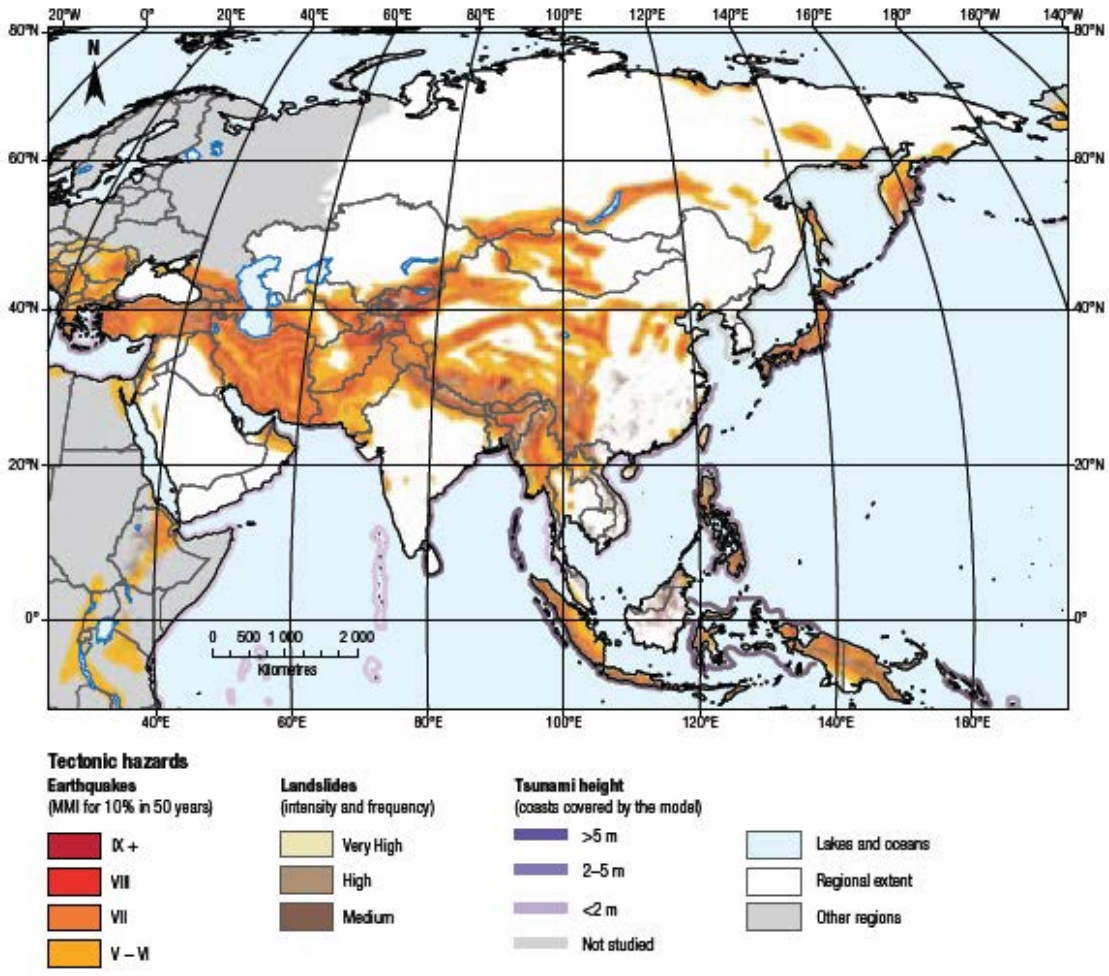
Sub Sector	Disaster Effects			Ownership	
	Damage	Losses	Total	Public	Private
Infrastructure					
Water Resources Management	8,715	-	**8,715**	8,715	-
Transport	23,538	6,938	**30,476**	30,326	150
Telecommunication	1,290	2,558	**3,848**	1,597	2,251
Electricity	3,186	5,716	**8,901**	5,385	3,517
Water Supply and Sanitation	3,497	1,984	**5,481**	5,481	
Productive					
Agriculture, Livestock and Fishery	5,666	34,715	**40,381**	-	40,381
Manufacturing	513,881	493,258	**1,007,139**	-	1,007,139
Tourism	5,134	89,673	**94,808**	403	94,405
Finance & Banking	-	115,276	**115,276**	74,076	41,200
Social					
Health	1,684	2,133	**3,817**	1,627	2,190
Social	-	-	**-**	-	-
Education	13,051	1,798	**14,849**	10,614	4,235
Housing	45,908	37,889	**83,797**	12,500	71,297
Cultural Heritage	4,429	3,076	**7,505**	3,041	4,463
Cross Cutting					
Environment	375	176	**551**	212	339
TOTAL	**630,354**	**795,191**	**1,425,544**	**141,477**	**1,284,066**

Source: DALA estimates, NESDB, and Ministry for Industry damages and losses.
Note: Losses for each sector include higher expenditures due to floods

No.:	EQ-001	Published Year:	2009
Study/ Report Name:	Global assessment report on disaster risk reduction (2009) Risk and poverty in a changing climate		
Access to Information:	http://www.unisdr.org/we/inform/publications/9413		
Research Organization:	United Nations International Strategy for Disaster Reduction Secretariat (UNISDR)		
Study Area (Country):	Worldwide		
Studied Hazard:	Tropical cyclones, Floods, Landslides, **Earthquakes** (10% in 50 years MMI), Drought, Tsunamis, Forest and other biomass fires		
Studied Damage/ Risk:	Multi-hazard risk		
Main Data Sources:			

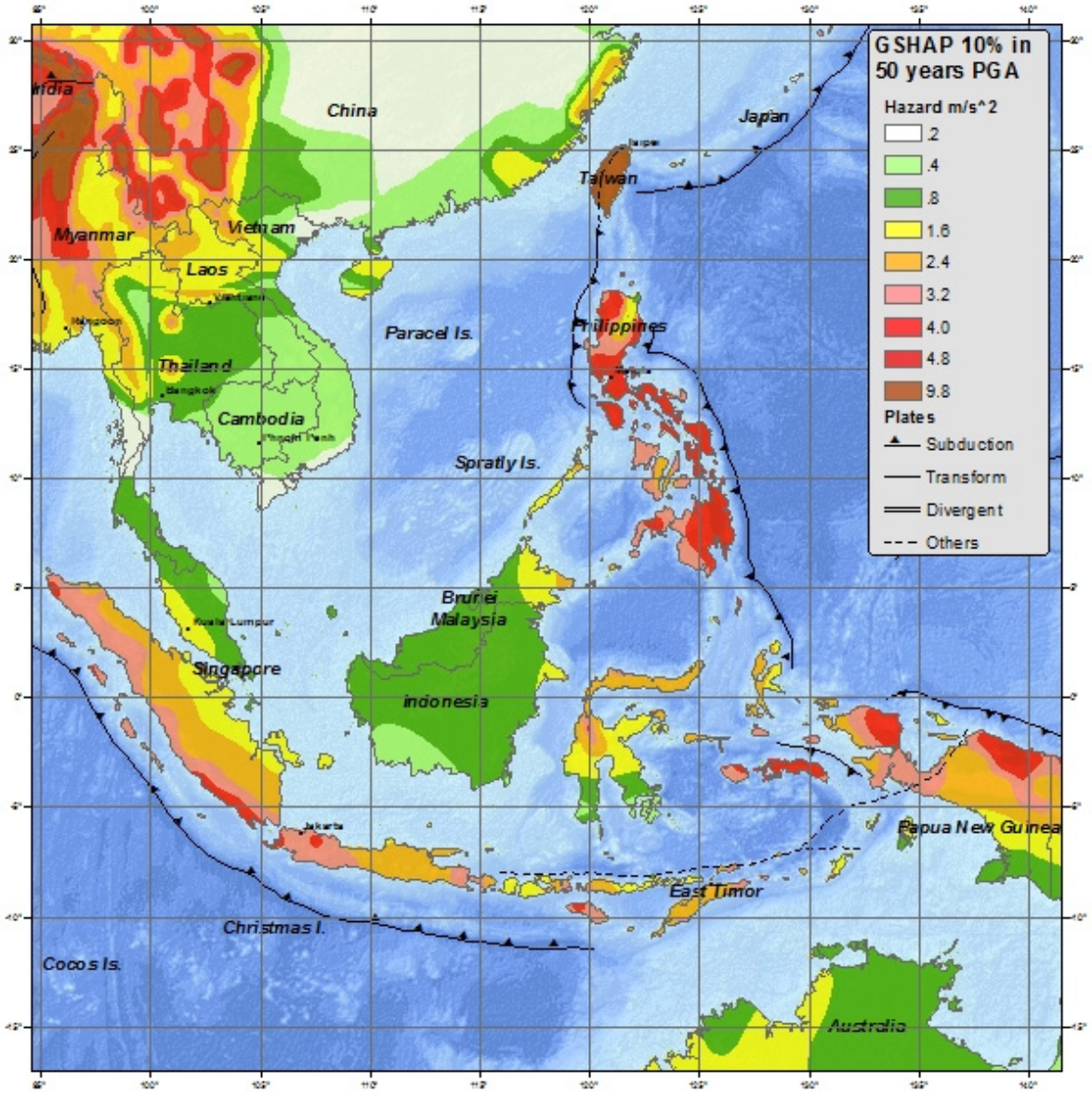
Summary of the Study:

An observation of disaster risk patterns and trends at the global level allows a visualization of the major concentrations of risk described in the report and an identification of the geographic distribution of disaster risk across countries, trends over time and the major drivers of these patterns and trends.



No.:	EQ-002	Published Year:	unknown
Study/ Report Name:	Seismic Hazard Map		
Access to Information:	http://earthquake.usgs.gov/earthquakes/world/indonesia/gshap.php		
Research Organization:	GSHAP, USGS		
Study Area (Country):	ASEAN		
Studied Hazard:	Earthquake / 10% in 50 years		
Studied Damage/ Risk:			
Main Data Sources:			

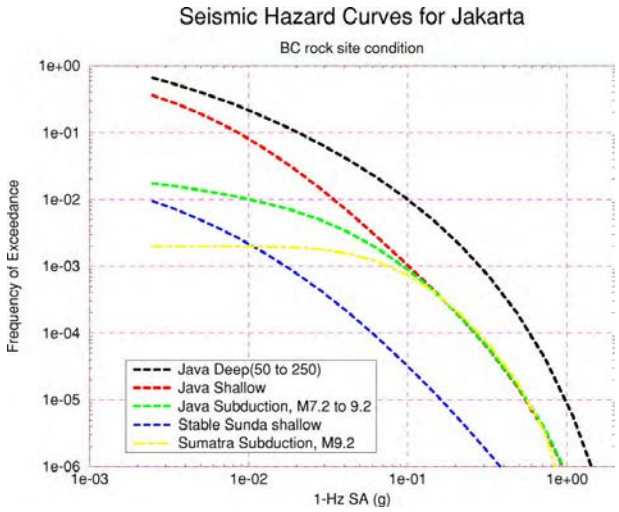
Summary of the Study:



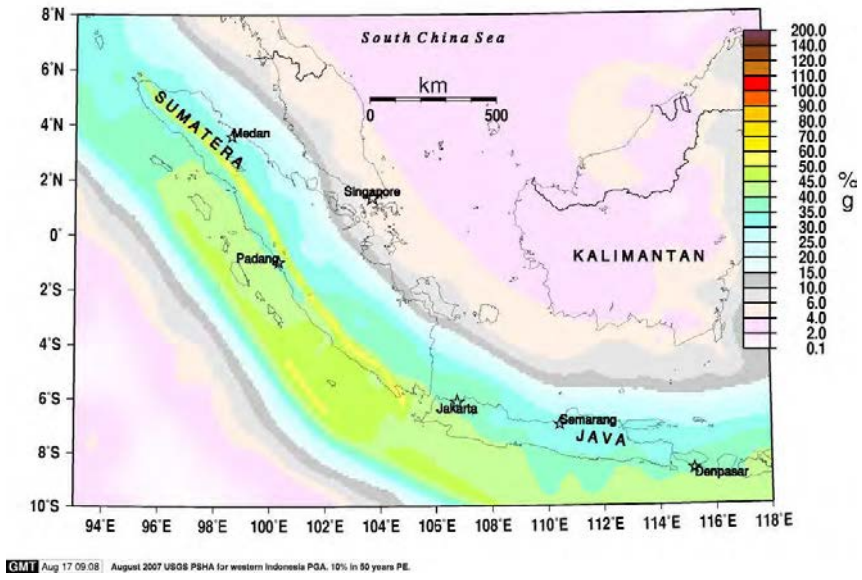
No.:	EQ-006	Published Year:	2007
Study/ Report Name:	Documentation for the Southeast Asia Seismic Hazard Maps		
Access to Information:	http://earthquake.usgs.gov/hazards/products/foreign/		
Research Organization:	USGS		
Study Area (Country):	**Indonesia**, Thailand, Malaysia / Jakarta, Bangkok		
Studied Hazard:	Earthquake / Probabilistic Seismic Hazard Analysis		
Studied Damage/ Risk:			
Main Data Sources:			

Summary of the Study:

The ground motion hazard for Sumatra and the Malaysian peninsula is calculated in a probabilistic framework, using procedures developed for the US National Seismic Hazard Maps.



PSHA PGA for western Indonesia PE= 10% 50 yr



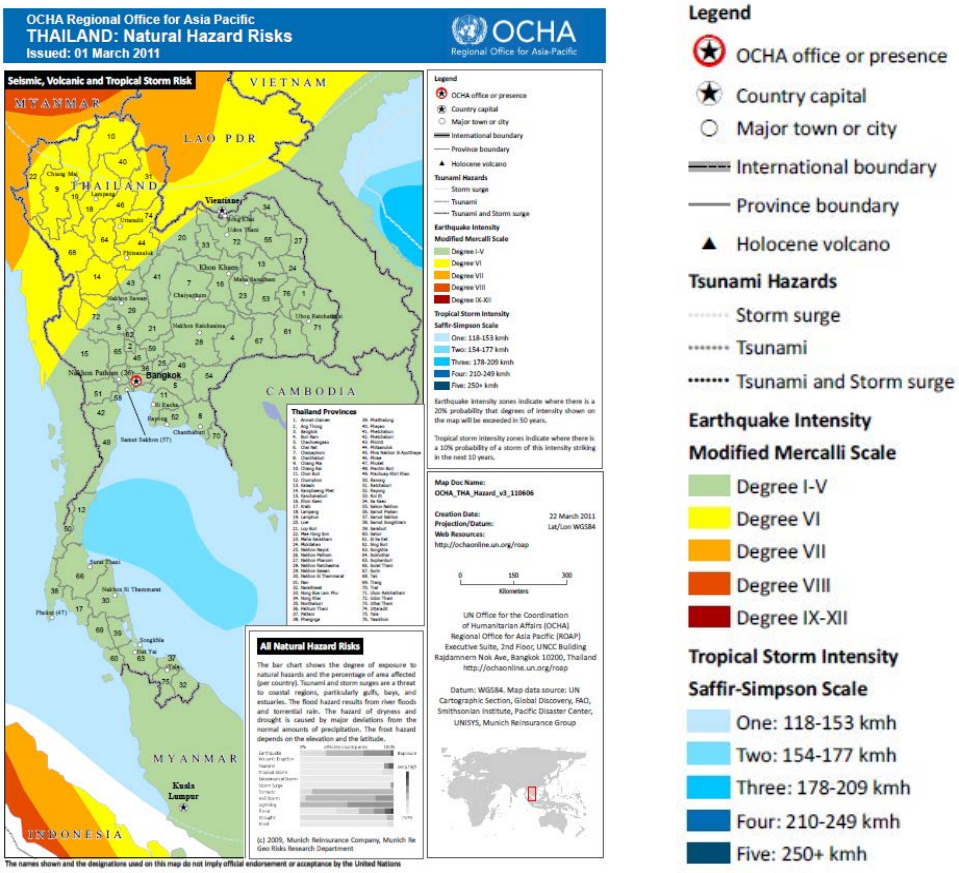
No.:	EQ-023	Published Year:	2011
Study/ Report Name:	THAILAND: Natural Hazard Risks		
Access to Information:	http://reliefweb.int/sites/reliefweb.int/files/resources/map_1300.pdf		
Research Organization:	United Nations Office for the Coordination of Humanitarian Affairs Regional Office for Asia and the Pacific (OCHA-ROAP)		
Study Area (Country):	Thailand		
Studied Hazard:	**Seismic**, Volcanic and Tropical Storm		
Studied Damage/ Risk:	All Natural Hazard Risks		
Main Data Sources:	UN Cartographic Section, Global Discovery, FAO, Smithsonian Institute, Pacific Disaster Center, UNISYS, Munich Reinsurance Group.		

Summary of the Study:

Earthquake intensity zones indicate where there is a 20% probability that degrees of intensity shown on the map will be exceeded in 50 years.

Tropical storm intensity zones indicate where there is a 10% probability of a storm of this intensity striking in the next 10 years.

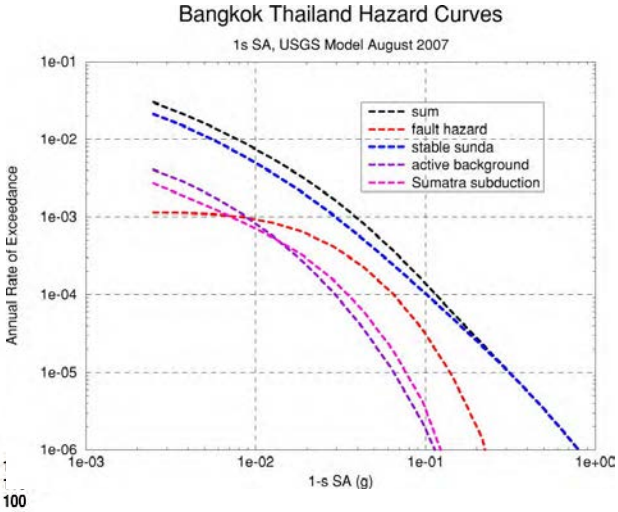
The bar chart shows the degree of exposure to natural hazards and the percentage of area affected.

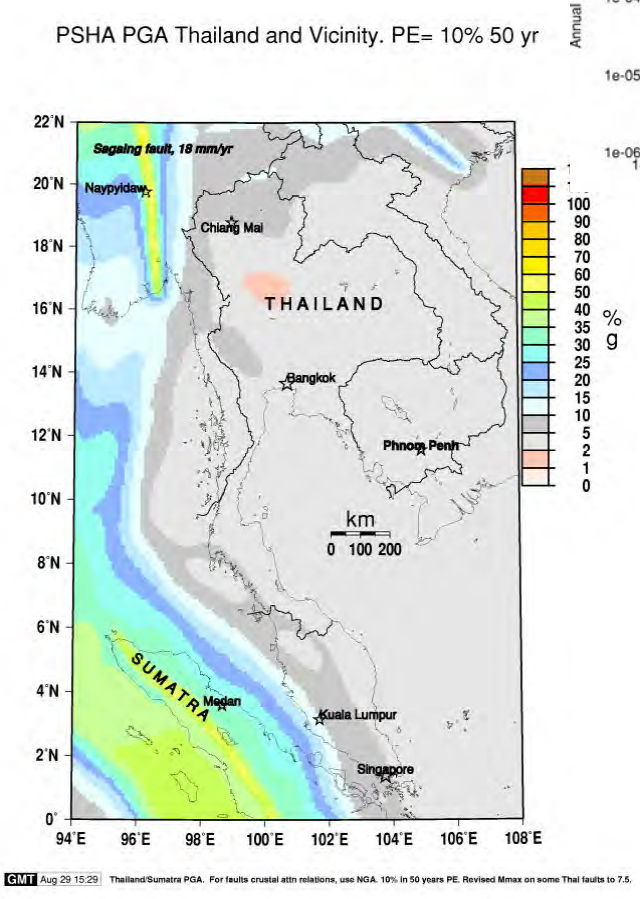


No.:	EQ-024	Published Year:	2007
Study/ Report Name:	Documentation for the Southeast Asia Seismic Hazard Maps		
Access to Information:	http://earthquake.usgs.gov/hazards/products/foreign/		
Research Organization:	USGS		
Study Area (Country):	Jakarta of Indonesia, Bangkok of Thailand, Malaysia		
Studied Hazard:	Earthquake / Probabilistic Seismic Hazard Analysis		
Studied Damage/ Risk:			
Main Data Sources:			

Summary of the Study:

The ground motion hazard for Sumatra and the Malaysian peninsula is calculated in a probabilistic framework, using procedures developed for the US National Seismic Hazard Maps.





No.:	TN-002	Published Year:	2005
Study/ Report Name:	From Disaster to Reconstruction: A Report on ADB's Response to the Asian Tsunami		
Access to Information:	http://www.adb.org/publications/disaster-reconstruction-report-adbs-response-asian-tsunami		
Research Organization:	Asian Development Bank		
Study Area (Country):	ASEAN		
Studied Hazard:	Tsunami		
Studied Damage/ Risk:			
Main Data Sources:			

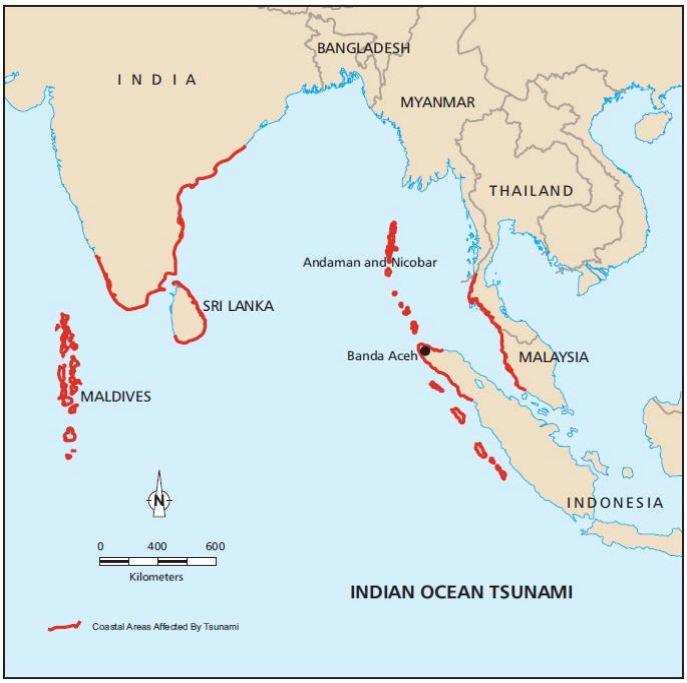
Summary of the Study:

This report summarizes ADB's response to the earthquake and tsunami during the first year. It highlights major activities, details project components, and identifies challenges ahead and lessons learned in responding to this unprecedented regional natural disaster.

Table 1: Tsunami Losses

Country	Number of			Estimated Overall Damage ($ billion)
	Dead	Missing	Displaced/ Injured	
India	12,405	5,640	6,913	2.560
Indonesia	131,029	37,000	556,638	4.500
Maldives	82	26	29,577	0.472
Sri Lanka	35,322		516,150	1.000
Thailand	5,395	2,817	54,500	0.711

Sources: Government of India: United Nations Development Programme: Government of the Maldives: Government of Sri Lanka: UN Resident Coordinator. Thailand.

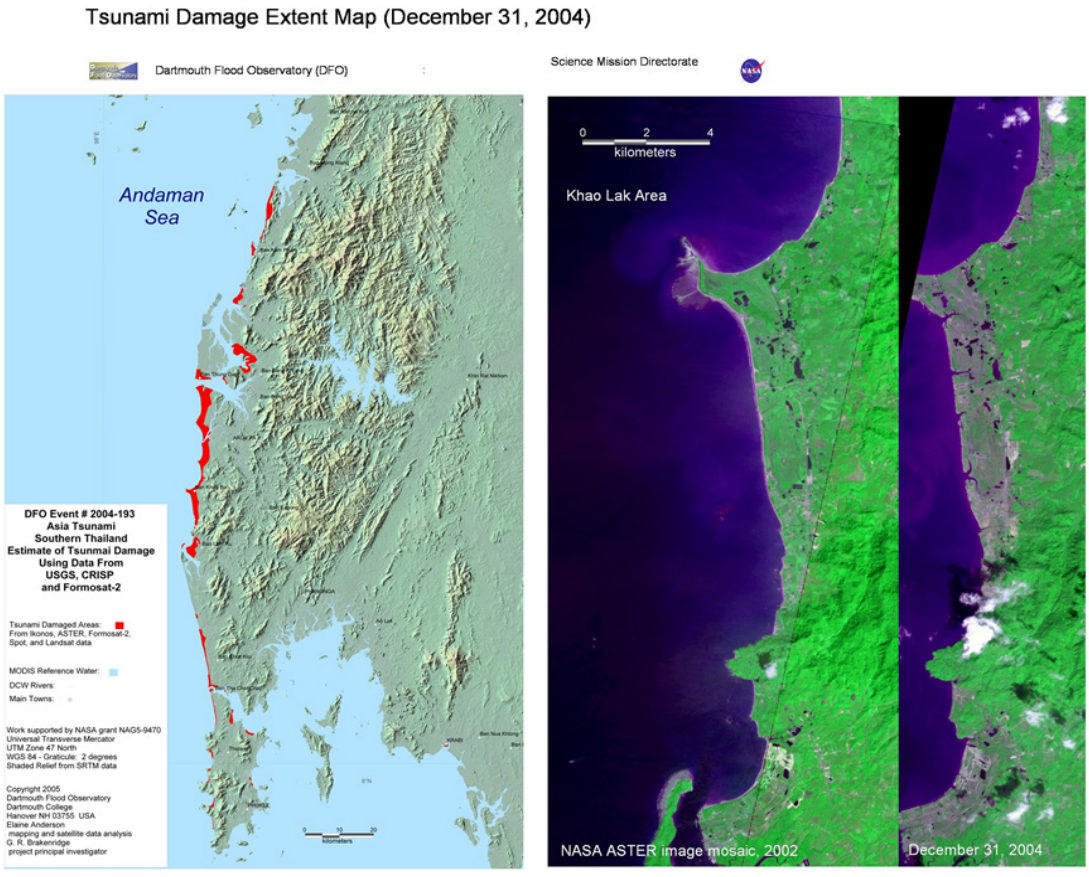


No.:	TN-012	Published Year:	2004
Study/ Report Name:	Tsunami Damage Extent Map (December 31 2004), Southern Asia - Earthquake and Tsunami - Indonesia, Sri Lanka and India (The Sumatra Earthquake of 26 December 2004)		
Access to Information:	http://www.dartmouth.edu/~floods/images/TsunamiThailandPoster.jpg		
Research Organization:	Dartmouth Flood Observatory		
Study Area (Country):	Southern Thailand		
Studied Hazard:	Tsunami (Inundation area)		
Studied Damage/ Risk:			
Main Data Sources:			

Summary of the Study:

<u>World Atlas of Large Flood Events 1985-2002</u>

The information presented in this atlas is derived from a wide variety of news, governmental, instrumental, and remote sensing source. It is designed in order to better understand the evolution of extreme flood events since 1985. The archive is "active" because it is currently updated (with current and past events).

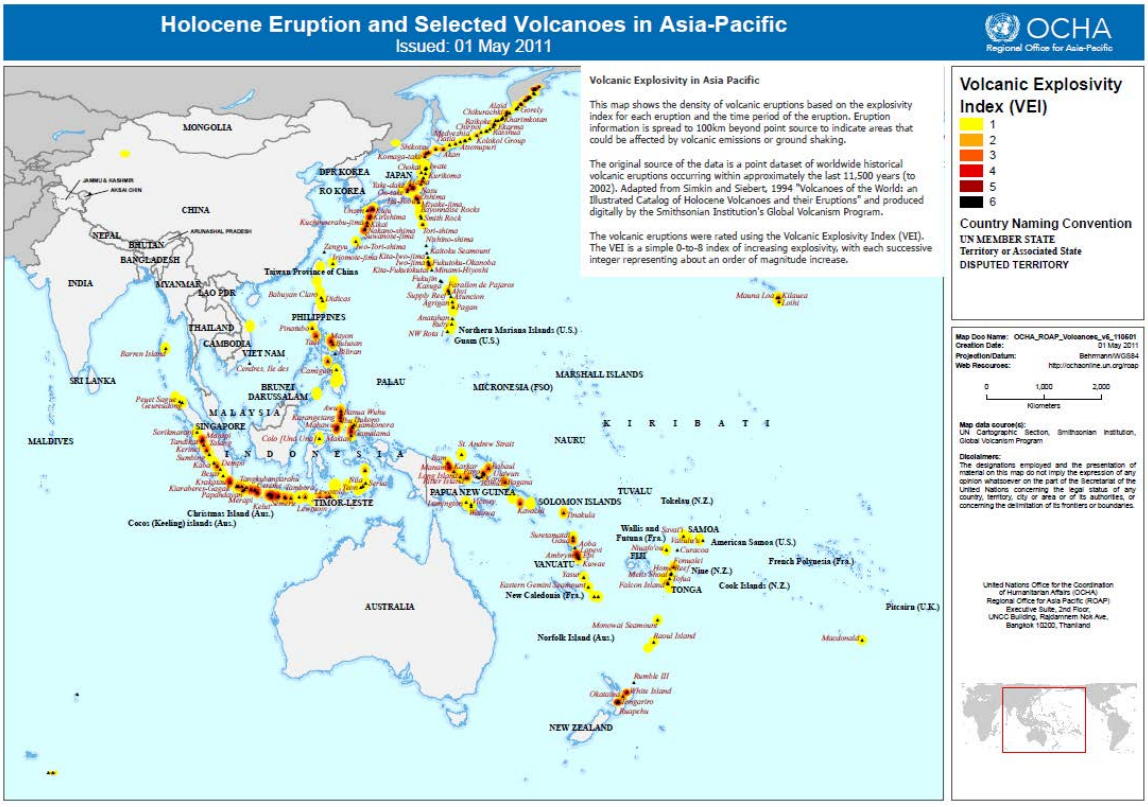


No.:	VE-001	Published Year:	2011
Study/ Report Name:	Holocene Eruption and Selected Volcanoes in Asia-Pacific		
Access to Information:	http://reliefweb.int/sites/reliefweb.int/files/resources/map_619.pdf		
Research Organization:	United Nations Office for the Coordination of Humanitarian Affairs, Regional Office for Asia Pacific (OCHA -ROAP)		
Study Area (Country):	Asia-Pacific		
Studied Hazard:	Volcanic Explosivity Index (VEI)		
Studied Damage/ Risk:			
Main Data Sources:	UN Cartographic Section, Smithsonian Institution, Global Volcanism Program		

Summary of the Study:

This map shows the density of volcanic eruptions based on the explosivity index for each eruption and the time period of the eruption. Eruption information is spread to 100km beyond point source to indicate areas that could be affected by volcanic emissions or ground shaking.

The volcanic eruptions were rated using the Volcanic Explosivity Index (VEI). The VEI is a simple 0 to 8 index of increasing explosivity, with each successive integer representing about an order of magnitude increase.



No.:	CM-002	Published Year:	2009
Study/ Report Name:	The Economics of Climate Change in Southeast Asia: A Regional Review		
Access to Information:	http://www.climatechange-foodsecurity.org/uploads/ABD_ec_climate-change-se-asia.pdf		
Research Organization:	UNESCO (ICHARM)/PERI		
Study Area (Country):	Indonesia, Philippines, Singapore, Thailand, Viet Nam (5 countries)		
Studied Hazard:			
Studied Damage/ Risk:	Hazard		
Main Data Sources:			

Summary of the Study:

The Economics of Climate Change in Southeast Asia: A Regional Review is the result of a 15-month long Asian Development Bank (ADB) technical assistance project, funded by the Government of the United Kingdom, which examines climate change issues in Southeast Asia, with a particular focus on Indonesia, Philippines, Singapore, Thailand, and Vietnam. The study is intended to enrich the debate on the economics of climate change that includes the economic costs and benefits of unilateral and regional actions. It seeks to raise awareness among stakeholders of the urgency of the grave challenges facing the region, and to build consensus of the governments, business sectors, and civil society on the need for incorporating adaptation and mitigation measures into national development planning processes. The study involves reviewing and scoping of existing climate studies, climate change modeling, and national and regional consultations with experts and policy-makers. It examines how vulnerable Southeast Asia is. to climate change, how climate change is impacting the region, what adaptation measures have been taken by the five study countries to-date, how great the region's potential is to reduce greenhouse gas (GHG) emissions in the future, how Southeast Asia can step up adaptation and mitigation efforts, and what the policy priorities are. Southeast Asia is highly vulnerable to climate change.

The study observed that climate change is already affecting Southeast Asia, with rising temperature, decreasing rainfall, rising sea levels, increasing frequency and intensity of extreme weather events leading to massive flooding, landslides and drought causing extensive damage to property, assets, and human life. Climate change is also exacerbating the problem of water stress, affecting agriculture production, causing forest fires, degrading forests, damaging coastal marine resources, and increasing outbreaks of infectious diseases. The report urges that Southeast Asian countries should treat adaptation as an extension of sustainable development practices. Its key elements include: adapting agricultural practices to changes in temperature and precipitation; adapting water management to greater risk of

floods and droughts; adapting coastal zone management to higher sea levels; safeguarding forest areas from forest fires and degradation; adapting people to threats of vector-borne infectious diseases. Southeast Asia countries need to take timely action to adapt to climate change, build resilience, and minimize the costs caused by the impact driven by GHG emissions that have been locked into the climate system.

Climate change is happening now in Southeast Asia, and the worst is yet to come. If not addressed adequately, it could seriously hinder the region's sustainable development and poverty eradication efforts—there is no time for delay. The review identifies a number of factors that explain why the region is particularly vulnerable. Southeast Asia's 563 million people are concentrated along coastlines measuring 173,251 kilometers long, leaving it exposed to rising sea levels. At the same time, the region's heavy reliance on agriculture for livelihoods—the sector accounted for 43% of total employment in 2004 and contributed about 11% of GDP in 2006—make it vulnerable to droughts, floods, and tropical cyclones associated with warming. Its high economic dependence on natural resources and forestry—as one of the world's biggest providers of forest products—also puts it at risk. An increase in extreme weather events and forest fires arising from climate change jeopardizes vital export industries.

Rapid economic growth and structural transformation in Southeast Asia helped lift millions out of extreme poverty in recent decades. But poverty incidence remains high—as of 2005, about 93 million (18.8%) Southeast Asians still lived below the $1.25-a-day poverty line—and the poor are the most vulnerable to climate change. The review has also assessed a wide range of evidence of climate change and its impact in Southeast Asia to date. It tells a clear story: mean temperature increased at 0.1–0.3°C per decade between 1951 and 2000; rainfall trended downward during 1960—2000; and sea levels have risen 1–3 millimeters per year.

No.:	CM-006	Published Year:	2012
Study/ Report Name:	THAILAND TECHNOLOGY NEEDS ASSESSMENTS REPORT FOR CLIMATE CHANGE ADAPTATION		
Access to Information:	http://tech-action.org/TNAreports/TechnologyNeedsAssessment-Adaptation_Thailand.pdf		
Research Organization:	UN		
Study Area (Country):	Thailand		
Studied Hazard:			
Studied Damage/ Risk:	Hazard		
Main Data Sources:			

Summary of the Study:

Thailand today faces a number of challenges affected by climate change. These include ever-increasing natural and human-made disaster such as extreme weather events, land-slide, flood, draught, rising sea level, biodiversity loss, and health damage, which if not addressed may lead to catastrophic consequences. Climate change is no longer a mere scientific concept owned by scientists but moved into our daily lives as more and more people become concerned with the complexity of this issue. The latest available data on greenhouse gas emissions from Thailand show that emissions continue to increase, underscoring the need for action while sustaining the economic reinforcement. To cope with the climate situation, it would be reasonable for Thailand to prioritize its technology strategies and identify problem areas in terms of policy objectives on mitigation and adaptation.

As a first step, it is necessary for Thailand to assess whether their current efforts in improving technological capability have been successful in supporting mitigation and adaptation. The review and analysis of Thai technologies could reflect whether the current technology-related policies and national research system support mitigation and adaptation and whether they are in harmony with other related impacts such as social acceptance and economic cost. Appropriate approaches to the technologies that would best-suit the stage of national development would be desirable. These investigations could provide a wide range of strategic options for policy-making both in the short and longer terms.

The National Science Technology and Innovation Policy Office (STI) continues to broaden and deepen its involvements in climate change mitigation and adaptation, particularly, in technology development and technology transfer policy. However, any technological change does not occur in isolation. It can have considerable impact on the people, culture, economy, and society in the overall context. Scientists, investors, economists and policy makers should work together towards developing technology with full awareness of the

complex interactions and relationships within the system. STI's aim is, therefore, to bridge the cooperation among government agencies, private sectors, academia and industry in strengthening the policy implementation in a sustainable manner. In response to the global and local climate concerns, STI conducts the research project entitled "Technology Needs Assessments and Technology Action Plans Report for Climate Change Mitigation/Adaptation in Thailand" among one of the first fifteen countries from Africa, Asia, Latin America, Caribbean, and Europe to conduct the projects funded by the UNEP Division of Technology, Industry and Economics (DTIE) in collaboration with the UNEP Risoe Centre.

No.:	LS-006	Published Year:	2010
Study/ Report Name:	● Synthesis Report on Ten ASEAN Countries Disaster Risks Assessment		
Access to Information:	http://www.unisdr.org/files/18872_asean.pdf		
Research Organization:	UNISDR/World Bank		
Study Area (Country):	An assessment of disaster risks in ten ASEAN countries		
Studied Hazard:	earthquakes, tropical cyclonic storms (typhoons), floods, landslides, tsunamis, droughts, and forest fires.		
Studied Damage/ Risk:	Hazard profile and Risk profile		
Main Data Sources:	CRED EM-DAT, ADRC, NGDC, GSHAP, MRC, WAMIS, DWR, Munich Re, World Bank, UNISDR, GAR, InTerragate, IFNet, and CCFSC, DESINVEN-TAR 1970-2009		

Summary of the Study:

1)overview

This synthesis report on the Ten ASEAN Countries is based on a desk review of existing studies by academia, governments and international governmental and non-governmental organizations. Risk assessments are carried out directly based on recorded historical losses. The economic loss probability estimates presented in this report are not intended for designing catastrophe insurance schemes, which require a much more detailed approach that models hazard, exposure and vulnerability of buildings and infrastructure.

2)landslide and mudslide analysis

Landslide and mudslide analysis data sources are shown in above table (Main Data Sources). The landslide hazard risks maps were derived from the GAR Preview platform (GAR, 2009; http://previewgrid.unep.ch), has 10km grid resolution. This report explains overview, Regional setting, Hazard profile and Risk profile of each 10 countries separately.

Assessment sample of Natural disaster (Indonesia)

Disaster Risk Statistics (1970-2009)				
Disaster type	*No. of disasters / year*	*Total no. of deaths*	*Deaths / year*	*Relative vulnerability (deaths/year/ million)*
Flood	3.20	5,420	135.50	0.56
Drought	0.20	1,329	33.23	0.14
Storm	0.23	1,692	42.30	0.18
Epidemic	0.83	3,886	97.15	0.40
Tsunami	0.08	83,525	2088.13	8.69
Earthquake	2.10	97,166	2429.15	10.11
Landslide	1.03	1,845	46.13	0.19
Volcano	0.93	661	16.53	0.07
Wildfire	0.23	300	7.50	0.03

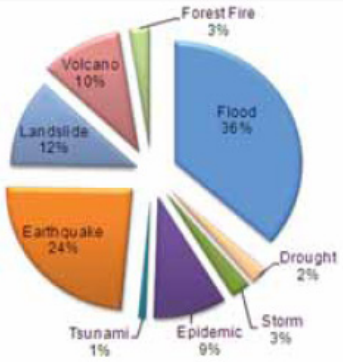


Figure 8: Percentage distribution of reported disasters in Indonesia

No.:	LS-007	Published Year:	2005
Study/ Report Name:	Natural Disaster Hotspots:A Global Risk Analysis		
Access to Information:	http://sedac.ciesin.columbia.edu/data/set/ndh-landslide-hazard-distribution/maps		
Research Organization:	World Bank、		
Study Area (Country):	Whole World		
Studied Hazard:	Flood, Landslide, Drought, drought,earthquakes, storms, volcanoes		
Studied Damage/ Risk:			
Main Data Sources:			

Summary of the Study:

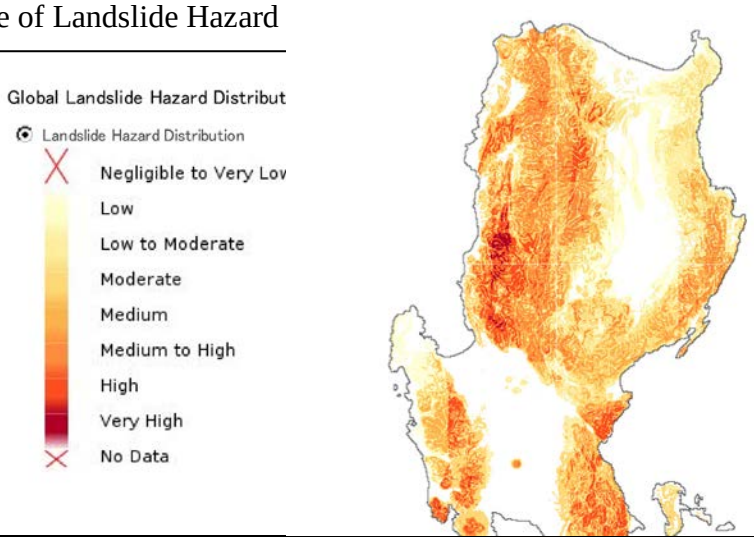
1)overview

This study presents a global view of major natural disaster risk hotspots—areas at relatively high risk of loss from one or more natural hazards. It summarizes the results of an interdisciplinary analysis of the location and characteristics of hotspots for six natural hazards. Data on these hazards are combined with state-of-the-art data on the sub-national distribution of population and economic output and past disaster losses to identify areas at relatively high risk from one or more hazards.This study belongs to the project of Global Risk Identification Program (GRIP) by the world bank, which objects a framework which is improved evidence base for disaster risk management to enable the application and prioritisation of effective disaster risk reduction strategies at the national, regional and global scales.

2)

And a web site of CIESIN publishes detailed risk map of 6 hazards distribution studied in this project as shown in below. The maps are able to estimate risk levels at sub-national scales.

Sample of Landslide Hazard ippines



No.:	LS-013	Published Year:	2009
Study/ Report Name:	Climate Change Vulnerability Mapping for Southeast Asia		
Access to Information:	http://web.idrc.ca/uploads/user-S/12324196651Mapping_Report.pdf		
Research Organization:	Economy and Environment Program for Southeast Asia (EEPSEA)		
Study Area (Country):	ASEAN (Thailand, Vietnam, Laos, Cambodia, Indonesia, Malaysia, and Philippines)		
Studied Hazard:	Flood, Landslide, Drought, Tropical, cyclone Sea level rise		
Studied Damage/ Risk:	Vulnerability to climate change, flood frequency		
Main Data Sources:	Urban Extent Database (GRUMP version 1) of the (CIESIN) GEODATA portal (the Environmental Database; http://geodata.grid.unep.ch/extras/datasetlist.php) BAKOSURTANAL		

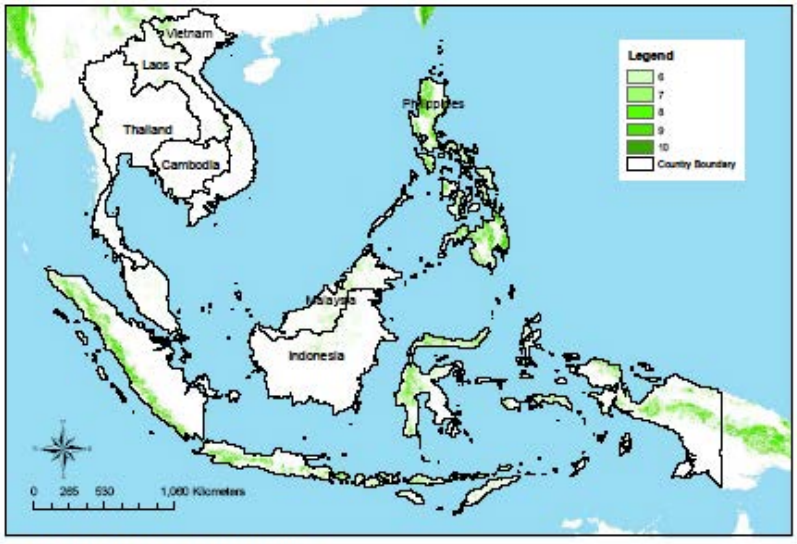
Summary of the Study:

This study assesses vulnerability of Southeast Asian countries (Thailand, Vietnam, Laos, Cambodia, Indonesia, Malaysia, and Philippines) of climate change including landslide. Vulnerability is defined as a function of exposure (potential loss due to a hazard), sensitivity (the potential gravity of losses and damage), and adaptive capacity (how much to adapt a hazard situation).

Adaptive capacity influences vulnerability. When adaptive capacity is low, vulnerability is high. Cambodia is among the most vulnerable in ASEAN despite its relatively low exposure to climate hazards. The eastern coast of Vietnam is susceptible to cyclones, but adaptive capacity is high to manage to moderate its vulnerability. Bangkok and Jakarta have high adaptive capacities but not enough to moderate their extreme vulnerability with high population densities and significant exposure to climate hazards.

A map shows annual landslide exposure of the region.

The map shows Landslide exposure changing rate caused by Climate change



Appendix 2D. Landslide exposure (2005)

Appendix 3:
List of Industrial Parks in Thailand

ID	Short List	LongList	COUNTRY	PROVINCE	PARK NAME	ADDRESS
TH0001			Thailand	Bangkok	Bangchan Industrial Estate	Khwaeng Si Phraya, Khet Bang Rak, Krungthep Mahanakorn 10500
TH0002			Thailand	Bangkok	Banthongkasem Industrial Estate	Khwaeng Si Phraya, Khet Bang Rak, Krungthep Mahanakorn 10500
TH0003			Thailand	Bangkok	Gemopolis Industrial Estate	Khwaeng Si Phraya, Khet Bang Rak, Krungthep Mahanakorn 10500
TH0004			Thailand	Bangkok	Jongsatit Industrial Park	Khwaeng Si Phraya, Khet Bang Rak, Krungthep Mahanakorn 10500
TH0005			Thailand	Bangkok	Kantana Movie Town (2002) Co., Ltd.	Khwaeng Si Phraya, Khet Bang Rak, Krungthep Mahanakorn 10500
TH0006			Thailand	Bangkok	Lardkrabang Industrial Estate	Khwaeng Si Phraya, Khet Bang Rak, Krungthep Mahanakorn 10500
TH0007			Thailand	Bangkok	Thapaya International Industrial City	Khwaeng Si Phraya, Khet Bang Rak, Krungthep Mahanakorn 10500
TH0008		**XXTH02**	Thailand	Chachoengsao	304 Industrial Park 2 2, 3, 6	Phanom Surakham District,Chachoengsao
TH0009			Thailand	Chachoengsao	Alpha Technopoolis Bonded Warehouse	Niyomthai Tambon Na Muang, Chang Wat Chachoengsao 24000
TH0010		**XXTH09**	Thailand	Chachoengsao	Gateway City Idustrial Estate	Gateway City Soi5 Rd. Hua Samrong,Plaeng Yao,Chachoengsao
TH0011		**XXTH25**	Thailand	Chachoengsao	Wellgrow Industrial Estate	Bang Pakog District, Chachoengsao
TH0012	**XXTH03**	**XXTH03**	Thailand	Chonburi	Amata Nakorn Industrial Estate	Ban Kao 6, Tambon Ban Kao, Chang Wat Chon Buri 20160
TH0013		**XXTH07**	Thailand	Chonburi	Chon Buri Industrial Estate(Bo Win)	331, Tambon Bo Win, Chang Wat Chon Buri 20230
TH0014			Thailand	Chonburi	Eastern Industrial Estate (Map Ta Phut) (Hemaraj EIE)	Tambon Bang Pla Soi, Chang Wat Chon Buri 20000,
TH0015	**XXTH10**	**XXTH10**	Thailand	Chonburi	Hemaraj Chonburi Ineustrial Estate (Hemaraj CIE)	3311 8-9 Moo6 High Way 331,Km.91-92,Bo-Win-Sub District,Muang Distrct,Chonburi
TH0016			Thailand	Chonburi	Leamchabang Industrial Estate	Tambon Bang Pla Soi, Chang Wat Chon Buri 20000,
TH0017			Thailand	Chonburi	Nong Bon Garden Industrial Zone	Tambon Bang Pla Soi, Chang Wat Chon Buri 20000,
TH0018		**XXTH17**	Thailand	Chonburi	Pinthong Industrial Estate 1	Si Racha District , Chon Buri
TH0019		**XXTH18**	Thailand	Chonburi	Pinthong Industrial Estate 2	Si Racha District , Chon Buri
TH0020		**XXTH19**	Thailand	Chonburi	Pinthong Industrial Estate 3	Si Racha District , Chon Buri
TH0021			Thailand	Chonburi	Saha-Group Industrial Park Sriracha	Tambon Bang Pla Soi, Chang Wat Chon Buri 20000,
TH0022		**XXTH04**	Thailand	Chonburi	Amata City Industrial Estate	700 Moo 1, Klong Tamru, Muang,Chombri 20000
TH0023			Thailand	Chonburi	Panthong Kasem Industrial Estate	Tambon Bang Pla Soi, Chang Wat Chon Buri 20000,
TH0024			Thailand	Chonburi	TFD Industrial Estate	Tambon Bang Pla Soi, Chang Wat Chon Buri 20000,
TH0025			Thailand	Kanchanaburi	Ratchaburi Industrial Estate	Tambon Ban Tai, Chang Wat Kanchanaburi 71000
TH0026			Thailand	Khon Kaen	Khon Kaen Small Industrial Estate 5	Khon Kaen, Thailand
TH0027			Thailand	Lamphun	Northem Region Industrial Estate	Rop Mueang Nai Tambon Nai Mueang, Chang Wat Lamphun 51000
TH0028			Thailand	Lamphun	Saha Group Industrial Park	Rop Mueang Nai Tambon Nai Mueang, Chang Wat Lamphun 51000
TH0029			Thailand	Nakhon Ratchasima	Nava Nakorn Industrial Zone Nakhon Ratchasima	224 Tambon Nai Mueang, Thesaban Nakhon Nakhon Ratchasima, Chang Wat Nakhon Ratchasima 30000

ID	Short List	LongList	COUNTRY	PROVINCE	PARK NAME	ADDRESS
TH0030		**XXTH23**	Thailand	Nakhon Ratchasima	Suranaree Industrial Zone	Suranaree Tambon Nai Mueang, Thesaban Nakhon Nakhon Ratchasima, Chang Wat Nakhon Ratchasima 30000
TH0031			Thailand	Nakhon Sawan	Network Industrial Estate	Phaholyothin Rd Tambon Pak Nam Pho, Thesaban Nakhon Nakhon Sawan, Chang Wat Nakhon Sawan 60000
TH0032			Thailand	Pathum Thani	Bankadi Industrial park	3111 Tambon Bang Prok, Chang Wat Pathum Thani 12000
TH0033			Thailand	Pathum Thani	Nava Nakorn	Thanon Navanakorn 5 Tambon Khlong Nung, Chang Wat Pathum Thani 12120
TH0034			Thailand	Pathum Thani	Thailand Science Park	3111 Tambon Bang Prok, Chang Wat Pathum Thani 12000
TH0035			Thailand	Pattani	Halal Food Industrial Estate	42 Tambon Chabangtiko, Chang Wat Pattani 94000
TH0036			Thailand	Phetchaburi	Khoa Yoi Industrial Park 1999-2000	Tambon Khlong Kra Saeng, Chang Wat Phetchaburi 76000
TH0037			Thailand	Phichit	Northem Region Industrial Estate	Phra Phichit 3 Tambon Nai Mueang, Chang Wat Phichit 66000
TH0038			Thailand	Phra Nakhon Si Ayutthaya	Bangpa-in Industrial Estate	Chikun Tambon Pratuchai, Thesaban Nakhon Phra Nakhon Si Ayutthaya, Chang Wat Phra Nakhon Si Ayutthaya 13000
TH0039			Thailand	Phra Nakhon Si Ayutthaya	Chutikam Factory House Industrial Estate	Chikun Tambon Pratuchai, Thesaban Nakhon Phra Nakhon Si Ayutthaya, Chang Wat Phra Nakhon Si Ayutthaya 13000
TH0040			Thailand	Phra Nakhon Si Ayutthaya	Factoryland Wang Noi 6	Khrongkan Tambon Wang Chula Rd Tambon Khao Ngam, Chang Wat Phra Nakhon Si Ayutthaya 13170
TH0041			Thailand	Phra Nakhon Si Ayutthaya	Hi-Tech Industrial Estate	Chikun Tambon Pratuchai, Thesaban Nakhon Phra Nakhon Si Ayutthaya, Chang Wat Phra Nakhon Si Ayutthaya 13000
TH0042	**XXTH20**	**XXTH20**	Thailand	Phra Nakhon Si Ayutthaya	Rojana Industrial Park(Ayutthaya)	Ban Khai Distrit , Rayong
TH0043			Thailand	Phra Nakhon Si Ayutthaya	Saha Rattana Nakorn	Chikun Tambon Pratuchai, Thesaban Nakhon Phra Nakhon Si Ayutthaya, Chang Wat Phra Nakhon Si Ayutthaya 13000
TH0044		**XXTH01**	Thailand	Prachinburi	304 Industrial Park	Si Maha Phot District, Prachin Buri
TH0045		**XXTH06**	Thailand	Prachinburi	Bor-Thong Industrial Zone	Near Bor Thong, Prachin Buri
TH0046		**XXTH13**	Thailand	Prachinburi	Kabinburi Industrial Zone	Near Kabin Bri rict District Prachin Buri (Near Kantary Hotel)
TH0047		**XXTH21**	Thailand	Prachinburi	Saha Group Kabinburi Industrial Park	Kabin Bri rict District Prachin Buri (Near Kantary Hotel)
TH0048			Thailand	Prachuap Khiri Khan	SV Western Seaboard	Sala Cheep Tambon Prachuap Khiri Khan, Chang Wat Prachuap Khiri Khan 77000
TH0049			Thailand	Prachuap Khiri Khan	Bangsaphan Steel Industrial Estate	Sala Cheep Tambon Prachuap Khiri Khan, Chang Wat Prachuap Khiri Khan 77000
TH0050			Thailand	Ratchaburi	Ratchaburi Industrial Estate	Amphoe Tambon Na Muang, Chang Wat Ratchaburi 70000
TH0051			Thailand	Ratchaburi	V.R.M. Ratchaburi Industrial Estate	Amphoe Tambon Na Muang, Chang Wat Ratchaburi 70000
TH0052		**XXTH05**	Thailand	Rayong	Amata City Rayong	Phon Prapha Tambon Mapyangphon, Chang Wat Rayong 21140
TH0053			Thailand	Rayong	Asia Industrial Estate	W 7 Rd Tambon Ban Chang, Chang Wat Rayong 21130
TH0054			Thailand	Rayong	C.P.Industrial Estate(Rayong)	Rural Road Chon Buri 5068 Tambon Khao Khan Song, Chang Wat Chon Buri 20110
TH0055			Thailand	Rayong	Eastern Industrial Estate Pic. (Map Ta Phut)	Thanon Sukhum Vit Tambon Noen Phra, Thesaban Nakhon Rayong, Chang Wat Rayong 21000
TH0056			Thailand	Rayong	Eastern Seaboard Industrial Estate(Rayong)	Rural Road Chon Buri 5068 Tambon Khao Khan Song, Chang Wat Chon Buri 20110
TH0057			Thailand	Rayong	G.K.Land Industrial Park	Thanon Sukhum Vit Tambon Noen Phra, Thesaban Nakhon Rayong, Chang Wat Rayong 21000
TH0058		**XXTH11**	Thailand	Rayong	Hemaraj Eastern Seaboard Industrial Estate	Moo4 Highway 331 K.M. 91.5 Pluak Deang Sub-District ,Pluak Deang District,Rayong

ID	Short List	LongList	COUNTRY	PROVINCE	PARK NAME	ADDRESS
TH0059		**XXTH12**	Thailand	Rayong	Hemaraj Rayong Industrial land	222 Moo 11 Ban Khai-Nong La Lok,Ban Khai District , Rayong
TH0060		**XXTH16**	Thailand	Rayong	Map Ta Phut Industrial Estate	I-ha Rd Tambon Map Ta Phut, Chang Wat Rayong 21150
TH0061			Thailand	Rayong	Padaeng Industrial Estate	Thanon Sukhum Vit Tambon Noen Phra, Thesaban Nakhon Rayong, Chang Wat Rayong 21000
TH0062			Thailand	Rayong	Rayong Industrial Land	Tambon Tha Pradu, Thesaban Nakhon Rayong, Chang Wat Rayong 21000
TH0063			Thailand	Rayong	Rojana Industrial Park(Rayong)	3138 Tambon Nong Bua, Chang Wat Rayong 21120 -> Pluak Daeng District, Rayong
TH0064		**XXTH22**	Thailand	Rayong	Siam Eastern Industrial Park	Thanon Sukhum Vit Tambon Noen Phra, Thesaban Nakhon Rayong, Chang Wat Rayong 21000
TH0065			Thailand	Rayong	SSP Industrial Park	Thanon Sukhum Vit Tambon Noen Phra, Thesaban Nakhon Rayong, Chang Wat Rayong 21000
TH0066			Thailand	Rayong	T.C.C.Industrial Park	3138 Tambon Nong Bua, Chang Wat Rayong 21120
TH0067			Thailand	Rayong	Thai Singapore 21	Thanon Sukhum Vit Tambon Noen Phra, Thesaban Nakhon Rayong, Chang Wat Rayong 21000
TH0068		**XXTH15**	Thailand	Rayong	Hemaraj Eastern Industrial Estate (Map Ta Phut)	Pakon Songkrohraj Rd. Huay Pong Sub-District,Muang District Rayong
TH0069			Thailand	Rayong	IRPC Industrial Estate (Ban Khai)	Thanon Sukhum Vit Tambon Noen Phra, Thesaban Nakhon Rayong, Chang Wat Rayong 21000
TH0070			Thailand	Rayong	IRPC Industrial Estate (Wang Chan)	3471 Tambon Bang But, Chang Wat Rayong 21120
TH0071			Thailand	Samut Prakan	Bangplee Industrial Estate	Thanon Sukhum Vit Tambon Pak Nam, Thesaban Nakhon Samut Prakan, Chang Wat Samut Prakan 10270
TH0072			Thailand	Samut Prakan	Bangpoo Industrial Estate	Thanon Sukhum Vit Tambon Pak Nam, Thesaban Nakhon Samut Prakan, Chang Wat Samut Prakan 10270
TH0073			Thailand	Samut Sakhon	Maharajnakorn Industrial Estate (under construction)	Hwy 3091Tambon Mahachai, Thesaban Nakhon Samut Prakan, Chang Wat Samut Sakhon 74000
TH0074			Thailand	Samut Sakhon	Samut Sakhon Industrial Estate	Hwy 3091Tambon Mahachai, Thesaban Nakhon Samut Prakan, Chang Wat Samut Sakhon 74000
TH0075			Thailand	Samut Sakhon	Sinsakhon Industrial Estate	Hwy 3091Tambon Mahachai, Thesaban Nakhon Samut Prakan, Chang Wat Samut Sakhon 74000
TH0076			Thailand	Saraburi	Kaengkhoi Industrial Estate 5	3041 Tambon Pak Prieo, Chang Wat Saraburi 18000
TH0077			Thailand	Saraburi	Nong Khae Industrial Estate	329 Tambon Nong Chik, Chang Wat Saraburi 18140
TH0078			Thailand	Saraburi	Saraburi Industrial Park	3041 Tambon Pak Prieo, Chang Wat Saraburi 18000
TH0079			Thailand	Saraburi	Siam Cement Industrial Land	3041 Tambon Pak Prieo, Chang Wat Saraburi 18000
TH0080			Thailand	Saraburi	SIL Industrial Land (Saraburi) 2, 4, 6	3041 Tambon Pak Prieo, Chang Wat Saraburi 18000
TH0081			Thailand	Sing Buri	Indra Industrial Park(Phase I)	Phan Ruaeng Tambon Bang Phutsa, Chang Wat Sing Buri 16000
TH0082			Thailand	Songkhla	Southern Industrial Estate	Karnjanavanit Tambon Khao Rup Chang, Chang Wat Songkhla 90000
TH0083			Thailand	Songkhla	Thepaya International MD.City	Karnjanavanit Tambon Khao Rup Chang, Chang Wat Songkhla 90000
TH0084			Thailand	Udon Thani	Udon Thani Industrial Estate	210 Tambon Nong Khon Kwang, Thesaban Nakhon Udon Thani, Chang Wat Udon Thani 41000
TH0085		**XXTH14**	Thailand	Bangkok	Lak Chai Rubber City Industrial Estate	238/9 Ratchadapisek Road, Huay Kwang Bangkok 10310
TH0086		**XXTH08**	Thailand	Rayong	Hemaraj Eastern Industrial Estate (EISE)	112 Moo 4 Highway 331 Km. 91.5 Pluak Daeng, Rayong 21140

ID	Short List	LongList	COUNTRY	PROVINCE	PARK NAME	ADDRESS
TH0087		**XXTH24**	Thailand	Chachoengsao	TFD Industrial Estate	TFD Industrial Estate Motor Way Road, Ta Sa-an Bang Pakong, Chachoengsao

Appendix 4:
General Investment Risk of Thailand

(1) Political Risk

Thailand is a constitutional monarchy with a parliamentary system of government. The prime minister is indirectly elected through parliamentary elections every five years. King Bhumibol Adulyadej does not intervene directly in politics, but is influential in that he is held in great esteem by all political parties and the Army.

Thai politics is divided between Red and Yellow Shirt-affiliated groups. Red Shirts are primarily rural residents and urban poor who support exiled Puea Thai party founder and former Prime Minister Thaksin Shinawatra. Yellow Shirt supporters are mostly middle and upper class urban residents and members of the monarchy, military and bureaucracy, many of whom support former Prime Minister Abhisit Vejjajiva's Democrat Party. The Army has intervened regularly in politics, with nine successful or attempted coups since 1971, most recently in 2006. In May 2010, the Army forcibly ended Red Shirts protests in Bangkok, killing over 80 civilians. Since the Puea Thai party's victory in the July 2011 elections, the Army and Prime Minister Yingluck Shinawatra, Thaksin's sister, appear to have reached an understanding that ensures their peaceful co-existence, short of a few trigger events.

In March 2013, Thaksin urged the Puea Thai party to approve amnesty laws for the Red Shirt supporters convicted of committing crimes during the 2010 violence. The Democrat Party opposes the laws and claim they would pave the way for Thaksin's return. However, Yingluck is unlikely to push for Thaksin's return until she has the support of the Army, without which a coup would become likely. Given that Thaksin's return is the most contentious issue in Thai politics, such an agreement is unlikely to be reached in the next year.

The King's death could be a potential trigger for a coup. The King is to be succeeded by Crown Prince Vajiralongkorn who has a close relationship with Thaksin. The military and the Privy Council have expressed concern about this relationship and would intervene if they perceived the new king was changing the political status quo. However, a coup would be met with a violent uprising, surpassing the level of violence seen in the 2010 protests. The Army would face civil unrest in the central Bangkok business districts of Ratchaprasong and Pathum Wan and an insurgency in

northern provinces such as Chiang Mai and Udon Thani. As such a coup would result in business disruption, but pro-business policies would likely remain once order was restored. The projected level of violence is likely to restrain both the Army and the Puea Thai, mitigating coup risks.

(2) Economic Risk

Driven by the post-flood surge in investment and private consumption, the economy grew 6.5% in 2012. It is questionable how long this momentum will last, though. It is quite likely that, on the consumption front at least, some of the 2012 over-performance involved pulling forward purchases that would have otherwise occurred in 2013, thereby weakening the outlook going forward. We expect investment growth to suffer from unfavorable base effects, but we still expect fairly robust investment spending, encouraged by ongoing incentives and lower corporate tax rates. We expect the economy to expand by 4.4% in 2013.

Despite rapid economic growth and higher incomes, inflation has remained remarkably low in recent quarters and is unlikely to turn problematic in 2013. That the robustness of domestic demand has not yet translated in demand-pull price pressures, probably due to sufficient supply conditions. The sufficient supply is a reflection of tame global commodity prices amid weak global demand. The Thai baht was stable early in 2013 but since mid-May has weakened as talk of the US Federal Reserve Bank's plans to taper its quantitative easing program has weighed on the currency. Further depreciation of the local currency would put upward pressure on import prices. We currently anticipate average consumer price inflation of 2.6% in 2013.

In light of growing competition from China, Vietnam, Indonesia, and other regional manufacturing centers, moving up the value-added chain is the Thai economy's challenge. Although this need is apparently recognized by policymakers, they have yet to engage in open debate or a concerted planning effort to develop Thailand's position as a more advanced producer. Currently, the country is uncomfortably stuck somewhere between a major agricultural and successful light industry producer, which has nonetheless failed to build up higher-value industries such as high-tech or bio-tech. Rather than strengthening the environment for foreign investment, the current administration has so far chosen to focus on developing local small and medium-sized enterprises to strengthen domestic activity and counterbalance any future drop in exports.

(3) Legal Risk

Thailand's legal system is generally satisfactory and effective in enforcing property and contractual rights. However, in practice, the legal processes can be slow and there is a need to improve the environment for foreign investors. Transparency is sometimes missing, and although the judiciary is generally independent, well-connected third parties have been known to influence the outcome of court cases through extra-legal means. There is also a widespread perception that the judiciary is politically biased – it has been selectively ruling against supporters of former Prime Minister Thaksin Shinawatra and the Puea Thai in a number of high-profile cases. Such issues are less prevalent in commercial cases.

(4) Tax Risk

The tax system in Thailand is modern and relatively simple compared to most other countries in the region. The corporate tax rate was lowered from 30% to 23% in January 2012, and further reduced to 20% on 1 January 2013. The new rates lower the direct tax burden levels for companies and bring them more in line with those in the other countries of the region. While Thailand's revenue department expects the rate reduction to result in revenue losses over the next few years, in the medium term the tax cut should improve Thailand's competitiveness in relation to its neighbors and boost foreign direct investment levels. The move is also in response to Thai business representatives' calls to cut corporate income tax permanently.

In August 2012, the Ministry of Finance announced its decision to maintain the country's value-added tax (VAT) rate at 7% until the end of September 2014. The VAT rate was reduced from 10% over a decade ago and this reduction was due to expire on 30 September 2012. Thai government is keen to keep the reduced VAT rate in place as it hopes to revive and promote the domestic economy following dramatic declines in industrial production during the October–November 2011 floods and amid global economic uncertainty. The 7% VAT rate is relatively low compared to other countries in the region, with Indonesia and Vietnam holding their standard VAT rates at 10%, and the Philippines at 12%. The populist Thai government will probably keep the reduced VAT rate in place even after the two-year extension period expires in order to keep the costs of living down.

Further improvements still need to be made to encourage entrepreneurship and close loopholes in the system that has led to widespread tax evasion. In GDP terms, the country's tax income is generally below regional standards, with funds generated by personal taxation particularly small. The investment incentive system is also in a need of reform, and would ideally be replaced with legislation more conducive to entrepreneurship.

(5) War Risk

Thailand's relations with neighboring states are largely positive, although there are border disputes with Cambodia. Thailand and Cambodia dispute a 4.6 sq km territory on around the Preah Vihear temple. From February-May 2011, both sides exchanged artillery rounds and gunfire, killing several soldiers and displacing thousands of villagers. From May 2011, a ceasefire has been in effect. The dispute is unlikely to develop into a wider conflict given election of a Puea Thai-led government in July 2011. Puea Thai founder and former Prime Minister Thaksin Shinawatra, has good relations with the Cambodian leader Hun Sen. Both sides argued their case in the International Court of Justice in April 2013 and a verdict is expected in October 2013. As the disputed area is small and rural, the border dispute poses no significant cargo and trade risks. The risk of conflict over the disputed territory would increase if the Democrat Party returns to power, regardless of the ICJ's verdict.

The presence of energy resources in the Gulf of Thailand has exacerbated maritime demarcation disputes with Cambodia. Three blocks in the gulf, with an estimated 10-11 trillion cubic feet of gas reserves, are subject to overlapping claims with Cambodia. The Cambodian government is willing to jointly develop the overlapping areas with Thailand so as to begin bidding rounds as quickly as possible, but Thailand prefers that the countries justify the existing claims instead. It is unlikely that military vessels will harass commercial vessels working at Thai or Cambodian offshore facilities.

Internally, there is a separatist insurgency in the far south is confined to the provinces of Songkhla, Pattani, Yala and Narathiwat, which have predominantly Thai-Malay and Muslim populations. Active military deployments are ongoing in these provinces.

(6) Terrorism Risk

We assess that southern separatists are unlikely to be able to widen the conflict to other parts of the country. Tourism assets, hotels, restaurants, banks, and other

commercial targets including automotive showrooms and rubber storage facilities, are at risk of crude IED attacks in the four southernmost provinces. The government is likely to seek a peaceful resolution of the insurgency. In February 2013, the Barisan Revolusi Nasional (BRN), one of the insurgent groups in the south, agreed to enter peace talks with the government. We assess that peace talks are unlikely to reduce attacks given that the BRN is one of several insurgent groups in the region and the other groups are likely to increase attacks to project their power and relevance.

(7) Civil Unrest Risk

Industrial unrest in Thailand is relatively infrequent and does not pose significant risks to business continuity. Most strikes occur in the greater Bangkok metropolitan area. These mainly involve walk-outs and picketing and rarely result in property damage. Strikes at state firms often involve demonstrations outside government offices in Bangkok. Strikes in the private sector are generally confined to single factories, mostly in the garment and manufacturing sectors.

Greater business continuity risks arise from the risk of politically-motivated protests, though this risk has been significantly reduced under the current Puea Thai government. If the Democrat Party were to return to power, protest risks would increase. Previous protests, both by the Puea Thai-aligned Red Shirts and anti-Thaksin Yellow Shirts, resulted in substantial loss of life as well as property damage to commercial and government assets in Bangkok. In May 2010, the Army forcefully ended protests by 100,000 Red Shirts, resulting in 91 deaths, while protesters set fire to over 30 government and commercial properties including the Central World Shopping Mall, causing about USD 1 billion in damage.